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THESIS

SYSTEM ENGINEERING ANALYSIS OF SQUADRON OFFICER COLLEGE

by

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March 2012

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13. ABSTRACT (maximum 200 words)

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Currently, SOC can graduate 4,060 students yearly and has facilities to handle over 6000 students per year. Increasing the percentage of staff that actively teaches has the greatest effect on throughput; 36% of staff are actively instructing. Administration and organization efficiencies should be explored to increase the percentage of active instructors.

Implementing a continuous improvement cycle could increase student learning regardless of throughput. Spiral development could be implemented to update lessons or the entire course. Customer feedback and stakeholder involvement need to be improved; currently, SOC customers, Air Force commanders, do not have a direct and timely way to influence curriculum design.
Using different delivery modalities, SOC may find new efficiencies or increase learning effectiveness. SOC should examine combinations of online delivery methods in order to reduce course length or costs.

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SYSTEM ENGINEERING ANALYSIS OF SQUADRON OFFICER COLLEGE

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LIST OF ACRONYMS AND ABBREVIATIONS

AAFES	Army and Air Force Exchange Service
ABC	Aerospace Basic Course
AETC	Air Education and Training Command
AFB	Air Force Base
AFH	Air Force Handbook
AFLC	Air Force Learning Committee
AFI	Air Force Instruction
AF-ISD	Air Force Instructional System Design
AFMAN	Air Force Manual
AFPC/CC	Air Force Personnel Center Commander
ASBC	Air and Space Basic Course
AU	Air University
BOT	Basic Officer Training
BOV	Board of Visitors
CBOA	Command Board of Advisors
CESG	Continuum of Officer and Enlisted Professional Military Education Strategic Guidance
CGO	Company Grade Officer
CLX	Cultural Leadership Exercise
CoL	continuum of learning
DoD	Department of Defense
ICL	Integrated Competencies List (ICL
IDE	Intermediate Developmental Education
INCOSE	International Council on Systems Engineering
ISD	Instructional System Design
JAG	Judge Advocate Generals
JFACC	Joint Force Air Component Commander
MAJCOM	Major Command
MECC	Military Education Coordination Council
OI	operating instructions

OPMEP	Officer Professional Military Education Policy
PCR	Periodic Comprehensive Review
PME	Professional Military Education
PPBS	Planning Programming and Budgeting System
SOC	Squadron Officer College
SOS	Squadron Officer School
TDY	temporary duty
TLP	Team Leadership Problem
USAF	United States Air Force

EXECUTIVE SUMMARY

Squadron Officer College (SOC) provides professional military education (PME) to captains in the U.S. Air Force through its Squadron Officer School (SOS). At the 2011 CORONA Top meeting Air Force leaders decided to increase the length of SOS. The increased course length created the need for a curriculum redesign beginning in the summer of 2011. This redesign offers a chance to apply systems engineering principles to improve requirements definition, system design, assessment, and efficiency.

Improved requirements elicitation, work-breakdown structure analysis, and capacity analysis are recommended to improve the effectiveness and efficiency of SOC. As the length of the course is constrained by other USAF needs, a method for trading requirement satisfaction using stakeholders is recommended to obtain as much value as possible from the time available. Significant efficiencies are identified that can result in increased student throughput, increased curriculum content, or both.

There are several design factors to consider when manipulating the SOC design space. Commanders, the chain of command, students, and faculty must all be given consideration. SOC stakeholders use requirements to create more effective military leaders, which are very important for mission execution. Cost, schedule, manpower, and learning requirements are important factors that shape the system. These elements were analyzed to determine their effect on the SOC design tradespace.

A systems engineering approach is recommended because of the system's complexity. Due to the variety of interests and people concerned with SOC, stakeholder interaction and curriculum design are complex. Second, the competing needs of stakeholders and outside organizations makes system interactions complex. Furthermore, the past approach of manipulating course length to increase student throughput ignores other factors available to system designers. A capacity analysis shows the current system is not being fully utilized; manpower, facilities, and schedule indicate greater throughput is possible.

Currently, SOC can graduate 4,060 students yearly and has facilities to handle over 6000 students per year. Increasing the percentage of staff that actively teaches has the greatest effect on throughput; 36% of staff are actively instructing. Administration and organization efficiencies should be explored to increase the percentage of active instructors.

Implementing a continuous improvement cycle could increase student learning regardless of throughput. Spiral development could be implemented to update lessons or the entire course. Customer feedback and stakeholder involvement need to be improved; currently, SOC customers, Air Force commanders, do not have a direct and timely way to influence curriculum design.

Using different delivery modalities, SOC may find new efficiencies or increase learning effectiveness. SOC should examine combinations of online delivery methods in order to reduce course length or costs.

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I.   INTRODUCTION

A.   BACKGROUND

Squadron Officer College (SOC) has been the U.S. Air Force's (USAF) sole provider of Company Grade Officer (CGO) Professional Military Education (PME) since 1950.   SOC's vision is to become the USAF's premier leadership-development institution.   The SOC mission is to develop Company Grade Officers as leaders of integrity ready to fly, fight, and win in air, space, and cyberspace (United States Air Force Squadron Officer College, 2011).   SOC has shaped itself to deliver leadership instruction to Air Force captains and their government civilian equivalents.

SOC conducts instruction through the Squadron Officer School (SOS) to meet its vision and goals. SOS has two forms of delivery: a 5-week residence course and a self-paced online correspondence course, which takes one to 12 months.   Both courses have the same mission but accomplish it in different ways.   The in-residence course has characteristics similar to a traditional in-residence university experience.   The campus at Maxwell Air Force Base (AFB) has classrooms, billeting, a full-time instructional staff, and on-site logistical support.   The correspondence course is a self-paced study program with no physical instructor-to-student interaction with delivery completely thru web-delivered documents.

In order to execute its mission, SOC is organized using the Air Force's Instructional System Development (AF-ISD) model.   This model takes a systems approach to establishing, executing, and continuing any type of Air Force instruction. This model uses spiral development and lifecycle metrics to shape all aspects of the college from its organization to its educational philosophy.   The ramifications of this model on the system will be described in detail in Chapter II.

B.   PURPOSE

This research defines SOC as a system and explores it using systems engineering concepts to identify potential improvements.   By using a systems approach, SOC may be better suited to execute its mission by producing a better product (CGOs) and more

effectively satisfy its customers (military commanders). A visual representation of the SOC system can be seen in Figure 1. SOC is given requirements from three sources, builds curriculum to satisfy the requirements, and then uses instructors to create the SOC product, SOS graduates.
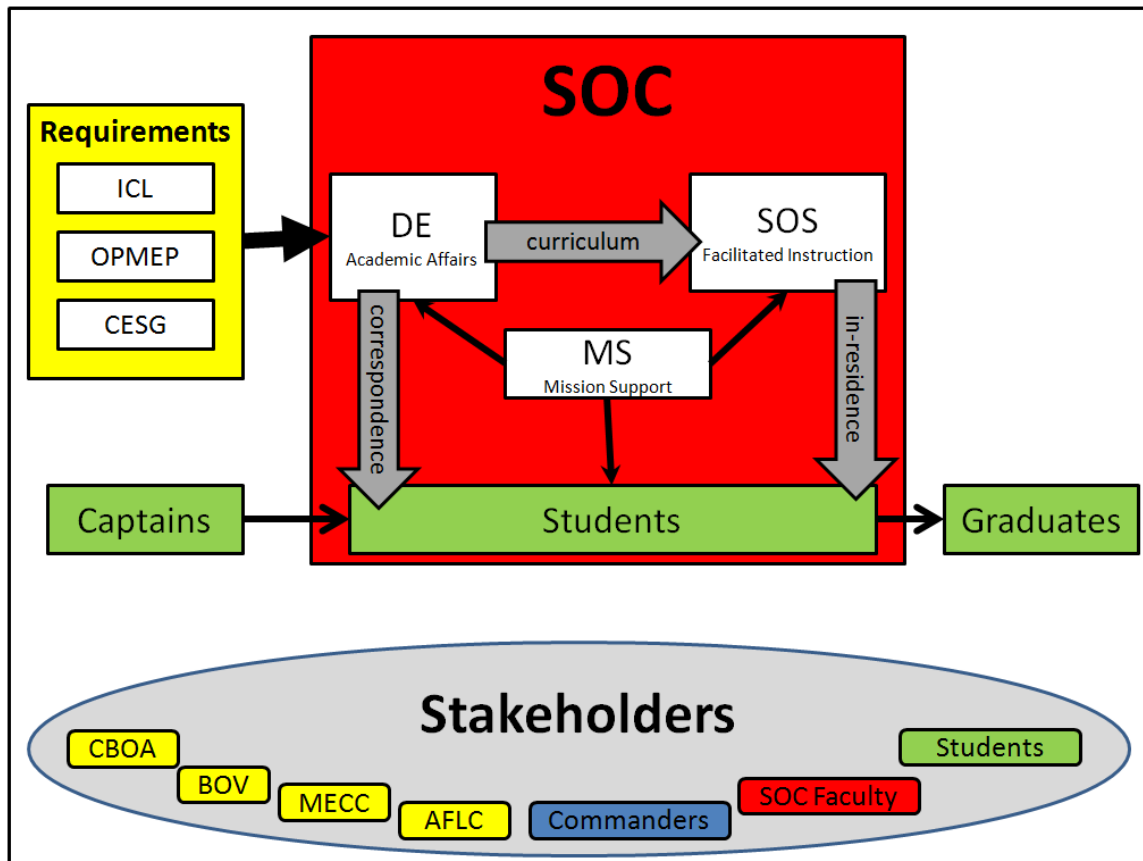
Figure 1.   SOC system representation.

In the past, the tradespace of class length, student eligibility, and class size have been used. This thesis expanded the tradespace to include increasing instructor numbers, spiral curriculum development, increasing the number of classes per year, and using different curriculum delivery modalities. Tradespace elements such as course length, student eligibility, and class size were identified but not manipulated during the analysis; these elements were not explored because they controlled at the highest levels of the Air Force. Not every stakeholder is fully involved in product development; currently,

stakeholders outside of the SOC faculty are involved in feedback after product implementation. The reactive nature of stakeholder involvement does not give customers a voice in key decisions. Customer involvement is of utmost importance is the SOC system.

SOC capacity has historically been adjusted by altering the length of course, but other design factors can be manipulated to increase student throughput. Currently, SOC has enough classrooms, lecture halls, and outdoor facilities to handle over 6000 students per year in an 8-week course. Scheduling changes, such as reducing down time between classes, increases throughput slightly; in an 8-week course, a continuous schedule increases throughput from 4,060 to 4,327.96 for an increase of 267.96 students per year. The design factor that has the greatest effect on throughput is the number of active instructors. SOC currently uses 36% of the total staff as active instructors, but further efficiencies in administration or organization should be explored to increase the percentage of staff available to instruct. There are enough qualified instructors (121 of 160 or 76%) to handle 8,470 students per year; however, the total student throughput is limited by the number of personnel actively instructing each class (36%). Using the current number of 58 instructors, capacity is limited to 4,060.

Student throughput is an important requirement, however, student learning must always be considered when adjusting throughput. Implementing a continuous improvement cycle through spiral development would increase student learning regardless of throughput. Spiral development could be implemented to update each lesson or the entire SOS course. As part of the continuous improvement cycle, customer feedback and stakeholder involvement need to be improved. Currently, SOC customers, Air Force commanders, do not have a direct and timely way to influence the SOC curriculum during the design phase.

Using different curriculum delivery modalities, SOC may find new efficiencies or increase learning effectiveness. SOC should examine combinations of asynchronous or synchronous online delivery methods in order to reduce course length or costs.

Combining online methods with in-residence learning may increase learning effectiveness or provide time savings. Different modalities could be testing using spiral development.

C. RESEARCH QUESTIONS

Both the SOC system and many of its processes are defined by various Air Force regulations, but many of the details of the system are not defined or directed by guidance from higher headquarters. The following questions were designed to identify SOC from a systems perspective and explore what changes can be made to the physical and functional system to make it more efficient or effective.

1. What is the problem?

2. What has been done before?

3. What are the system boundaries?

4. What are the design factors? Design space?

5. What is the objective? How do you measure it?

6. What are the alternatives?

7. How are the alternatives scored?

8. How are the costs of alternatives estimated?

9. What is the recommended alternative? Why?

10. What are the implications?

11. What future work can be done?

D. BENEFITS OF STUDY

Examining SOC from a systems perspective allows SOC leadership to better understand the factors affecting their organization. Describing the organization as a system allows commanders to visualize the interactions and interdependencies that guide SOC's day-to-day and long-term functioning. Understanding all of the available design space gives SOC leadership multiple ways to adjust the system.

Efficiencies developed at SOC have a cascading effect on the entire U.S. Air Force. The Air Force commits 80% of its captains for five full weeks to attend SOS in residence totaling over 3,000 captains per year. During that time, the officer is relieved of his primary duties to focus solely on SOS. SOS completion is mandatory for career progression. Captain Alexandra Kish, a finance officer at SOC, states SOC's annual operations and maintenance budget is $1.6 million (A. Kish, personal communication, October 24, 2011). Other costs include facilities costs, military personnel costs of faculty and students, and temporary duty costs. Both in terms of manpower hours and dollars, SOC represents a significant investment for the USAF.

This investment is made to improve leadership. Captains are senior to 83% of the Air Force; therefore, more effective captains have the potential to influence 263,437 personnel (USAF Almanac, 2011). Furthermore, all current and future Air Force leaders will have graduated from SOS. SOS is the only PME program dedicated to teaching leadership, a necessary skill for officers. The skills learned at SOS can be used by all Air Force officers to help all other Airmen.

E.   SCOPE AND METHODOLOGY

The scope of this thesis will focus on the Squadron Officer School for captains and civilian equivalents. The now defunct Air and Space Basic Course (ASBC) for second lieutenants (once a part of SOC) will not be considered.

The methodology defined SOC as a system with requirements, stakeholders, and customers. The current system is described, design space defined, and ways to improve the physical and functional system are suggested.

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II. LITERATURE REVIEW

This research defines SOC as a system and explores it using systems engineering concepts to identify potential efficiencies. By using a systems approach, SOC may be better suited to execute its mission by producing a better product (CGOs) and more effectively satisfying its customers (military commanders). Literature reviews of SOC, SOS, and PME show many articles about leadership theory, establishing more opportunities for CGOs to receive professional military education, and effectiveness of PME. The literature review found no writings about the current physical or functional organization of SOC or ways to improve the system working within the existing design space. A history of SOC provided useful background on earlier design issues (Ritchie, 2000). Sister services CGO PME was examined, but the focus and differences were too great to fit within the scope of this thesis.

A. PROFESSIONAL MILITARY EDUCATION

There are several documents that direct SOC as a PME organization. The most significant of these documents are the Officer Professional Military Education Policy (OPMEP), Air Force Instruction 36-2301, and Air Force Policy Directive 36-26 Integrated Competencies List (ICL), and Air University Continuum of Officer and Enlisted Professional Military Education Strategic Guidance (CESG). Figure 2 is a graphic representation of the requirements process.
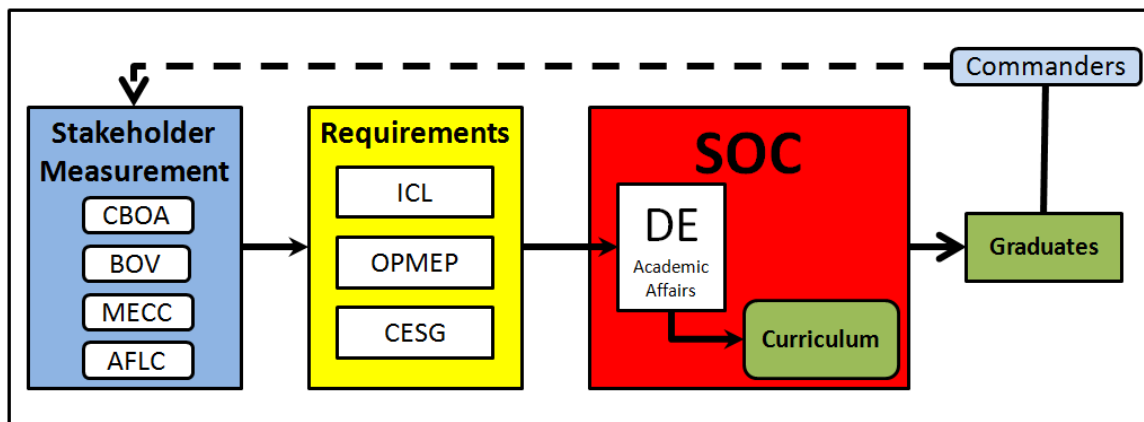
Figure 2.   SOC requirements process.

The Chairman of the Joint Chiefs of Staff outlines the intent of PME in the OPMEP:

> Professional development is a product of a learning continuum that comprises training, experience, education, and self-improvement. PME provides the education needed to complement training, experience, and self-improvement to produce the most professionally competent (strategic-minded, critical-thinking) individual possible. (Chairman of the Joint Chiefs of Staff, 2009).

Education is focused primarily on the cognitive domain of learning with special emphasis on solving complex problems. Education differs from training, which focuses primarily on the psychomotor domain, but both are included in many military schools. The OPMEP provides a roadmap for all services to frame their officer PME. PME is first organized into school levels commensurate with rank: primary for grades O-1 through O-3, intermediate for O-4, senior for O-5 and O-6, and General/Flag officer level. Each level's focus is defined and intended to build upon previous levels. "PME conveys the broad body of knowledge and develops the habits of mind essential to the military professional's expertise in the art and science of war" (Chairman of the Joint Chiefs of Staff, 2009). Squadron Officer College is defined as primary PME, which is defined as education typically received by officers ranked from O-1 through O-3. The OPMEP defines the focus of primary education for all of the services.

> Primary education focuses on preparing junior officers to serve in their assigned branch, warfare, or staff specialty. The curricula are predominantly Service oriented, primarily addressing the tactical level of war. Service schools that have programs centered on pay grade O-3 officers will foster an understanding of joint warfighting necessary for success at this level. Joint learning areas are embedded in Service PME instruction. (Chairman of the Joint Chiefs of Staff, 2009)

PME is also required to prepare officers for joint service. Joint warfighting fundamentals, organization, structure, and capabilities are to be introduced.

Air Force Policy Directive 36-26 outlines the Air Force personnel plan for total force development. This document contains direct guidance for institutions such as SOC in the Institutional Competency List. United States Air Force (2008) policy directive 36-26 defines the ICL as the following:

The common taxonomy used to implement the continuum of learning (CoL). These competencies are expected of all Airmen, throughout their careers, and will be the competencies needed to operate successfully in the constantly changing environment they function in. (p. 8)

Table 1 lists the competencies and sub-competencies contained in the ICL. The ICL determines the subjects that must be covered in the SOS curriculum, which has an effect on the length of the class. Each level of PME must provide enough class time to sufficiently cover all of the ICL subjects at the required level of learning.

Institutional Competency	Institutional Subcompetency
Employing Military Capabilities	Operational and Strategic Art
	Unit, Air Force, Joint and Coalition Capabilities
	Non-Adversarial Crisis Response
Enterprise Perspective	Enterprise Structure and Relationships
	Government Organization and Processes
	Global, Regional and Cultural Awareness
	Strategic Communication
Embodying Air Force Culture	Ethical Leadership
	Warrior Ethos
	Develop Self
	Followership
Leading People	Developing and Inspiring Others
	Taking Care of People
	Diversity
Managing Organizations and Resources	Resource Stewardship
	Change Management
	Continuous Improvement
Strategic Thinking	Vision
	Decision-Making
	Adaptability
Fostering Collaborative Relationships	Build Teams and Coalitions
	Negotiating
Communicating	Speaking and Writing
	Active Listening

Table 1.   Institutional Competencies List (ICL) (From United States Air Force, 2008).

Air Force Instruction 36-2301 states the rules for PME attendance, eligibility, selection, and removal. This instruction states that the Air Force Personnel Center Commander (AFPC/CC) will distribute quotas to each MAJCOM and other agencies. It also directs Air Education and Training Command and Air University responsibilities in developmental education. This document directs Air University to use Air Force Instructional System Development (AF-ISD) and maintain staff and facilities to conduct resident and non-resident programs. Other sections discuss accreditation of AU programs and AU registrar responsibilities. To be eligible for SOS, a student must be a captain with four to seven years of total Air Force commissioned service at class start (United States Air Force, 2010).

SOC receives guidance from Air University through the Continuum of Officer and Enlisted Professional Military Education Strategic Guidance document. The CESG describes the continuum of professional military education and how Air University aligns with the ICL. The primary level of education, SOS, is designed to give company grade officers a "big picture" understanding of air, space, and cyberspace power. CGOs are to understand how air and space power support the Joint Force Air Component Commander (JFACC) and the value of teamwork. CGOs must learn to lead small groups, follow as part of a team, and respond to being tasked. The CESG defines the five core areas of study for PME: profession of arms, warfare studies, leadership studies, international security studies, and communication studies. The CESG (United States Air Force Air University, 2009) defines each area as follows:

> **Profession of Arms.** The goal of this core area is to study the military as a profession and the characteristics that separate the uniformed service from the society it serves. It focuses on distinctive knowledge, exclusive group coherence, career structure, and the airmen's role in society. It also addresses core values, discipline, professional ethics dress and appearance, oath of office, drill and ceremonies, customs and courtesies, accountability, and security awareness.

> **Warfare Studies.** The central focus is on the study of the military instrument of national power. This core area develops an understanding and appreciation of the nature of war and the art of employing military power across the range of military operations. Warfighting includes historical and modern roles and missions, force structures, joint operations, core competencies, and tactics across the spectrum of conflict and the domains such as land, sea, air, space and cyberspace in order to develop an understanding of the theories, strategies, and doctrinal underpinnings of how best to achieve national security objectives.

> **Leadership Studies.** This core area focuses on the study of developing and inspiring the human dimension of leadership from individual to organizational levels. Broad categories in this area include leadership styles, organizational leadership, functions of management, and command responsibilities. It draws from the study of great leaders to develop an understanding and appreciation of the professional, organizational, and interpersonal dimensions of influencing and directing people and other resources to accomplish the mission.

> **International Security Studies.** International Security Studies develops an understanding and appreciation of the nature and functioning of the

international system and the strategic environment. Broad categories in this core area include the nature and causes of war and peace, patterns of change and major global and regional trends, contemporary problems and issues, and maintaining global vigilance using intelligence capabilities. Special emphasis is accorded the non-military instruments of power and how they affect global, regional, and national security conditions, problems and issues. It also includes the study of national security strategy and the national security decision-making process, civil-military relations, and critical contemporary regional and functional problems/issues.

Communication Studies. Communication Studies develops an understanding, appreciation, and ability to apply principles of effective communication (speaking, listening, writing, research, and non-verbal communications). Broad categories in this core area include interpersonal, small-group, and organizational dynamics, cross-cultural communications, and the attendant processes and networks for communication. This core area also involves relations with the media and the nuances of persuasion, rhetoric, negotiation, and propaganda. Additionally, the impact of technology on the communication process should be addressed in this core area (pp. 6–7).

Early SOC history was captured by the first commandant of Squadron Officer College, Colonel Russell V. Ritchey. Col. Ritchey's book seeks to clarify the reasoning behind decisions made during SOC's inception (Ritchey, 2000). The author goes into great deal to explain the traditions and practices established in the early days of SOC. Many of Col. Ritchey's organizational ideas stemmed from his own professional military education and employment at varied institutions including the Calvary School, the Royal Air Force Staff College, Command and General Staff School, Army Air Force Staff College, Air Tactical School and Air University. Squadron Officer College was created with the purpose of developing officers in the military profession. Col. Ritchey wanted a military school taught solely by officers emphasizing practical application and group discussions. Col. Ritchey wanted the curriculum to be developed first and then determine the length of the course. Other Air Force leaders were concerned about the lack of a junior officer school and made the creation of SOC possible.

In 2009, AETC sponsored a study by the University of Texas at Austin to look at converting SOS into a blended learning course in order to increase student throughput. The study looked at the 5-week SOS in-residence course and estimated that

approximately two weeks are needed for in-residence activities while the remaining 3 weeks could be completed through various distance learning methods. Much of the distance learning would consist of live, virtual activities in order to allow team-based collaborations. The study concentrates on the steps necessary to convert the course and the steps the challenges of conversion (Mayrath & O'Hare, 2009). The process to convert SOS in-residence into a blended learning course is presented as a 12-phase conversion. The process is described as a spiral development effort. Phase 1 is an initial planning phase involving examining objectives, the syllabus, assessments, and students. Phase 2 is a baseline evaluation of the course that incorporates student feedback. Phase 3 is the initial technology and tool development phase. Phase 4 trains instructors to use the identified technologies. Phase 5 converts the existing course content into online modules. Phase 6 consists of beta testing using instructors, experts, and Air University staff. Phase 7 uses a representative sample of SOS students to conduct a pilot test. Phase 8 evaluates the pilot test while Phase 9 modifies the course based on the tests and feedback. Phase 10 is a summary evaluation comparing the in-residence and blended learning courses. Phase 11 is the full implementation of a blended learning SOS. Phase 12 is a periodic review of the program. The University of Texas at Austin study identified five challenges to converting to a blended learning course. The greatest challenge is getting commitment and buy-in from senior level leadership. The second challenge deals with the "Digital Divide." Some Airmen will not be as comfortable or familiar with the technology required to complete a blended learning course. Student motivation may be impacted by access to computer hardware or bandwidth. The third challenge is inadequate infrastructure such as bandwidth, computer hardware, or access to military websites from home. The fourth challenge is that students must be given dedicated time free of primary duties to complete their schoolwork. The fifth challenge is ensuring the Air Force uses the proposed conversion method to develop a blended learning course. The University of Texas at Austin study recommendations are being used to develop an SOS blended learning prototype during the 2012 academic year.

B. EDUCATION AND BLENDED LEARNING THEORIES

SOC operates its curriculum design and instruction using adult leaner theory. Malcolm Knowles theorized about adult learning principles, which differ from children's learning. Adult learners need to know the reasons they are learning something. Adults learn through experience including mistakes. Adults need to be involved in the planning and evaluation of their instruction. The learning must have relevance to the learner's life. Adults use a contextual, problem-centered orientation to learning. Adults use internal motivation to learn (Knowles, 1984). These principles are considered when designing SOC curriculum as well as delivering curriculum in the classroom. However, one major factor that is not discussed in the literature is the mandatory nature of SOS. The mandatory nature of SOS is counter to Knowles theory of internal motivation for adult learners. Students must complete SOS in order for their careers to progress, which is an external motivational factor.

Many institutions have already implemented blended learning in their curriculum. Dr. Matthew Stafford, SOC Chief Academic Advisor, states SOC is looking at blended learning as a possible option to reduce in-residence course length (personal communication, October 28, 2010). Many authors suggest that instructional design and modality must be coordinated. When implementing blended learning, some authors suggest that lesson objectives must be designed before the modality (Goldstein & Ford, 2002; Clark, Bewley, & O'Neil, 2006; Sugrue & Clark, 2000). Other authors argue that learning objectives must be written after determining modality, because understanding the desires of the learner and the organization determines the development of learning objectives (Morrison, Ross, & Kemp, 2007). Blended learning is being considered because it may reduce the amount of time students are away from their primary job without reducing learning outcomes.

Clark, Bewley, and O'Neil (2006) devised a way to measure the cost-benefit of modality through a cost per student ratio. The cost per student ratio is calculated by totaling all development, production, and transmission, and travel expenses and then dividing the cost by the number of students projected to tack the class. Often, the media are chosen ahead of the instructional design due to an organization's desire to use a

specific medium or technology. Some organizations can use this analysis to determine the most cost effective media for their purposes. To support using the cost per student ratio, Clark et al. reference findings by Sugrue and Clark (2000) who concluded that learning objectives achieved in one medium can be achieved by another medium or combination of media and reach the same level of learning. While using different media may allow students to reach the same level of learning, Clark et al. refer to Salomon (1984) finding that media can have different motivational qualities because learners have different beliefs and expectations. Also supporting the theory that different media can achieve the same levels of learning is Bernard et al. (2004) who showed that using two different media platforms achieved the same amount of learning but had differing motivational results (Clark, Bewley, & O'Neil, 2006).

Clark et al. state how distance learning may increase access and efficiency:

Most reviewers agreed with Cobb (1997) and Clark (1983, 2001) that media may have a significant impact on student access to instruction, and the cost (Levin, 1983) and efficiency of their learning (Cobb, 1997). Presumably, distance education is a potential solution to instructional access problems when students are widely distributed geographically and when travel is either more expensive or less convenient than "distance" access via the Internet or television transmission. In addition, when large numbers of students must be served, there may be a considerable economy of scale in serving them at a distance. Both access and scale are economic issues that can and should be addressed in an a priori, cost/benefit analysis (e.g., Levin, 1983; Levin & McEwan, 2001). (p. 135)

The conditions in the paragraph above readily describe SOC: geographically distributed students, inconvenient travel, and a large number of students. Students are distributed at bases around the globe. Synchronous, live transmission is difficult due to the various time zones in which students and faculty are located. Internet and television access are usually available; however, mission needs are also competing for resources. Students must fulfill their primary mission (such as flying, managing troops, running operations) making travel and time out of the duty day for distance education very inconvenient.

Another issue with using blended learning for SOC is the complex nature of the learning objectives. Complex tasks must be accompanied by corrective feedback in order

to support learning (Clark, Bewley, & O'Neil, 2006). In order for a complex task such as leadership to be learned, immediate feedback is necessary and is best done with a live coach. SOC curriculum, like many other curriculums, is based on a large, complex overall objective that is broken down into smaller, less complex objectives. Mastering the subtasks does not automatically lead to mastering the larger task. There is a need for complex practical exercises to allow students to practice and for a live, expert coach to give feedback (van Merrienboer, 1997).

C.   CHAPTER SUMMARY

Professional Military Education is directed by several documents, most notably the OPMEP, ICL, and CESG. These documents define the five core areas of study for all PME including SOC.

SOC's initial years were recorded by the First commandant of Squadron Officer College, Colonel Russell V. Ritchey. Col. Ritchey goes into great detail discussing the history of many traditions at SOC. He also explains the rationale for SOC's organization and methods of instruction. The University of Texas at Austin conducted a study to determine what portions of the SOS course could be delivered online in a blended learning format. The study examined existing curriculum for delivery modality changes but did not approach building curriculum designed for blended learning. Educational theory plays an important role in curriculum design. In the past, more attention has been paid to cost benefits of blended learning instead of learning benefits. More recent research has examined both cost and learning effectiveness of blended learning. The SOC system has not been fully explored by scholars. Some debate whether there should be more or less military education or whether that education is effective, few examine the current system and explore how it may be improved.

III. DEFINING THE SOC SYSTEM

A. INTRODUCTION

The military chain of command shapes the SOC organization and function. Figure 3 shows the SOC chain command. SOC is a subordinate unit of the Carl A. Spaatz Center for Officer Education. The Spaatz Center is the Air Force's unifying organization for all officers' Professional Military Education (United States Air Force Carl A. Spaatz Center for Officer Education, 2011). The Spaatz Center reports to Air University. Air University is the Air Force's center for military education. Air University is part of Air Education and Training Command (AETC), the Air Force Major Command (MAJCOM) responsible for all Air Force military training and education. AETC reports to Headquarters, United States Air Force (United States Air Force Air Education and Training Command, 2011).
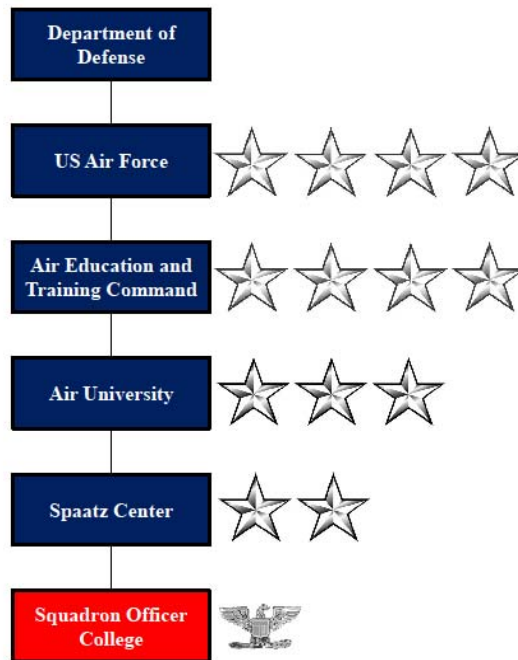
Figure 3.   SOC chain of command (From S.C. Lipinski, personal communication, November 8, 2011).

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According to the Squadron Officer College Staff Directory, there are three major functional organizations within SOC. SOS and its four student squadrons implement the curriculum at SOC and make up approximately 61% of SOC's manpower. The squadrons are made up of instructors called flight commanders. Each flight commander has a 14-student class called a flight. Flights are the basic unit used to deliver instruction at SOS. The second major functional unit at SOC is Academic Affairs branch (SOC/DE) and is 22% of SOC's manpower. Academic Affairs is responsible for curriculum development, correspondence courses, and instructor training. The majority of SOC/DE responsibility is devoted to developing, maintaining, and updating lesson plans (instructional materials). The third major function at SOC is Mission Support branch (SOC/MS). Mission Support provides much of the logistics for day-to-day and long term functioning of the school and is 9% of SOC's manpower. Mission Support includes facilities management, computer support, and student registrar functions. Figure 4 shows the functional organization at SOC. Under the SOS Commandant the student squadrons appear in red boxes. Academic Affairs appears in white boxes while Mission Support appears in green boxes. The black boxes in the gray section are the now defunct ASBC. Figure 5 is a functional hierarchy diagram of Squadron Officer College. The three primary missions in SOC are providing logistical support, management, and education. Within education, there are two functions, providing instruction and providing curriculum for instruction. SOC has a similar functional and physical organization. The mission of providing logistical support is accomplished by the Mission Support branch. The mission of providing management is accomplished by the Commandants staff and heads of each branch. The function of providing instruction is accomplished by the SOS student squadrons while the function of providing curriculum is accomplished by the Academic Affairs branch.
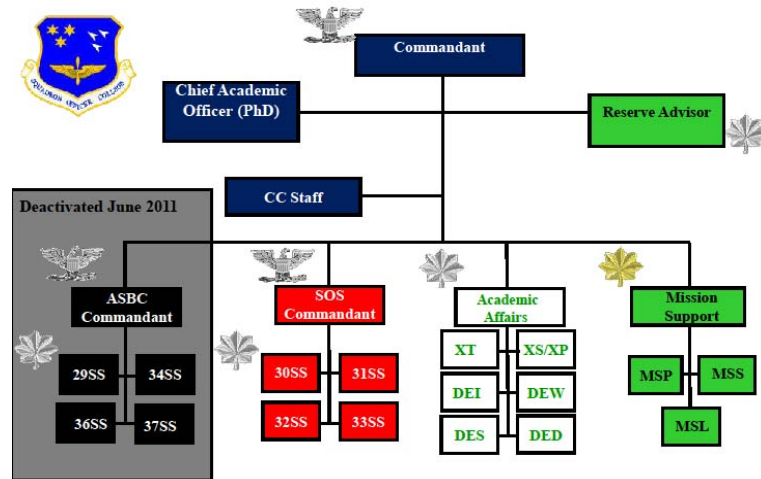
Figure 4.   SOC organizational chart (From S.C. Lipinski, personal communication, November 8, 2011).
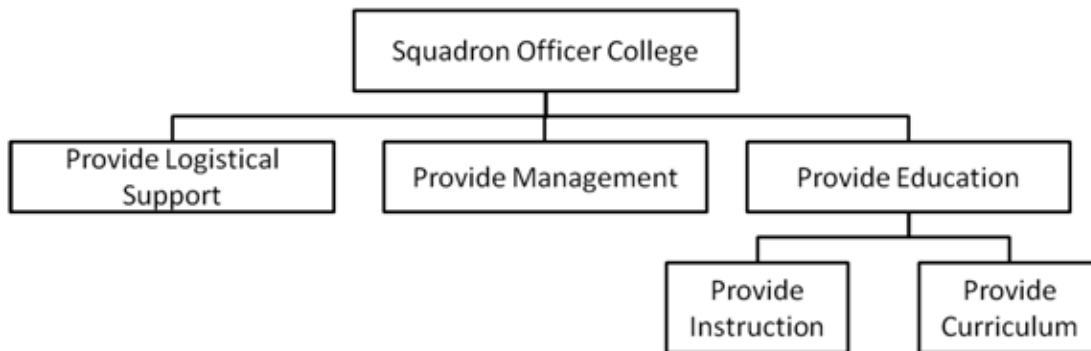
Figure 5.   Functional Hierarchy Diagram.

B.   AIR FORCE INSTRUCTIONAL SYSTEM DESIGN

SOC is modeled after a system called the Air Force's Instructional System Design also called AF-ISD or ISD. United States Air Force Handbook 36-2235 vol. 1 (2002) states:

> The Air Force ISD process is a conceptual adaptation of the systems engineering process to the problems of developing, implementing, and evaluating instruction. ISD results in alternative solutions to instructional problems which may be more or less cost-efficient, depending on the

instructional need and environmental constraints. ISD also clarifies that a systems approach, which involves choosing among alternative solutions, will produce the most effective results.

In other words, ISD is used as a systematic approach to decide what and how to teach. It covers the entire spectrum of education from deciding if education is necessary, to executing a class or analyzing feedback from students and instructors on the class to determine if improvements are needed. ISD transforms job requirements into the instruction needed to produce graduates with the skill, knowledge and attitudes necessary to accomplish their mission. SOC is modeled around the AF-ISD model. There are direct connections between ISD functions and instructional phases and SOC functions and instructional phases. Figure 6 is a visual representation of ISD.
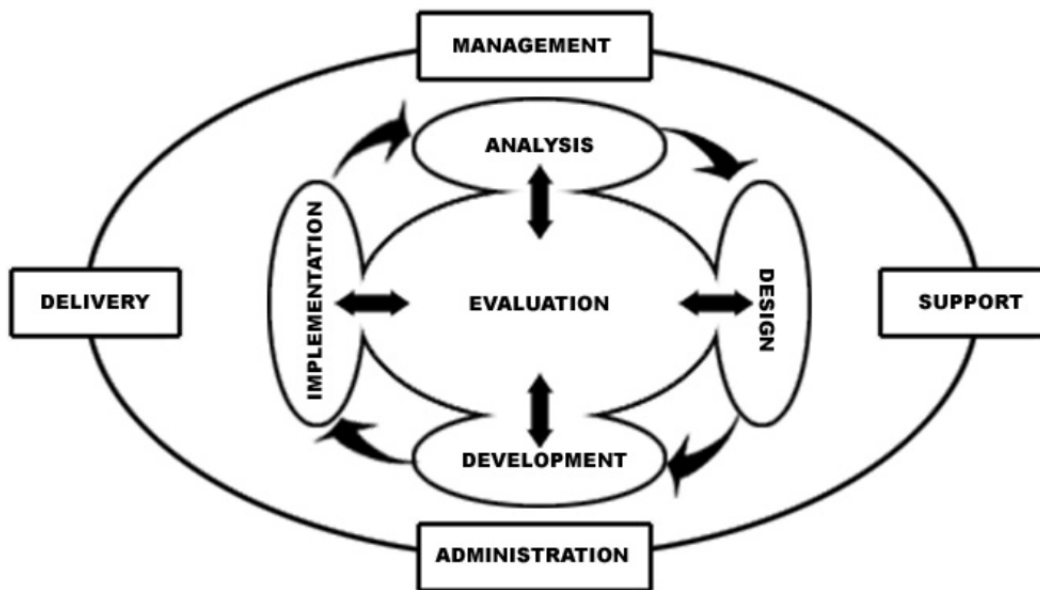
Figure 6.   AF-ISD model (From United States Air Force, 2002).

The ISD model is composed of three parts: system functions, ISD phases, and quality improvement.

1. ISD System Function

System functions are defined as functions that must be in place in order for an educational program to operate. There are five ISD system functions: manage, support, administer, deliver, and evaluate. The system functions are active throughout all phases. Figure 7 is a visual representation of ISD that highlights the relationship between the system and its constraints.
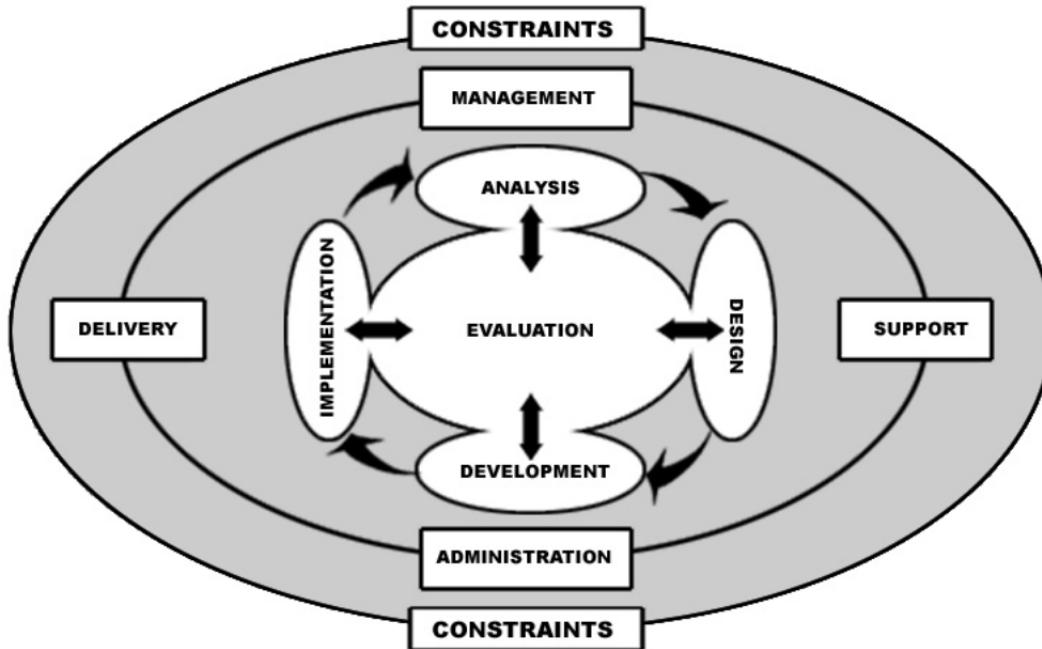
Figure 7.   AF-ISD model (From United States Air Force, 2002).

a.   *Management Function*

The manage function is defined as "the function of directing or controlling instructional system development and operations" (United States Air Force, 2002). Management activities include planning, organizing, coordinating, evaluating, and reporting.

First, management must plan for the design, development, support, operation, and maintenance of the instructional system. The SOC front office and staff spearhead management efforts. Second, management must organize the required resources for the system. SOC resources include money for operations and manpower for

faculty. Third, management must coordinate the system's operations and support. Fourth, management must evaluate the effectiveness and efficiency of the system. Fifth, management must report the status of development and operation of the system.

SOC handles management functions through the organizational hierarchy of the SOC Commandant, the SOS Commandant, SOS squadron commanders, Director of Mission Support (MS), and the dean of academic affairs (SOC/DE). The primary coordination in SOC is driven by each SOS class operation requiring support from the other departments, academic affairs (DE) and mission support (MS). SOC management evaluation tools include student, alumni, and supervisor surveys for indirect measurement. Written assignments (essays), briefings, and experiential events (such as the Project X obstacle course) are direct measurements of student learning. These events are witnessed or reviewed by flight commanders who subjectively measure student learning.

b. Support Function

The support function includes all the tasks needed to implement, operate, and maintain the system. These tasks can be day-to-day or long-term activities. There are several support functions occurring simultaneously at SOC. SOC supplies include various classroom and office supplies (chairs, desks, projectors, pens, pencils, computers, computer networks, phones). Maintenance support functions include computer and network support and building maintenance. Instructional material production is also classified as a support function. SOC instructional materials consist primarily of lesson plans. Construction support of SOC exists as the building, its classroom, and outdoor activity areas (Project X obstacle course, sports fields). Funding as a support function is supplied through military operations and maintenance money. Support services include feeding of students thru the Army and Air Force Exchange Service (AAFES) snack bar.

Managers are responsible for ensuring adequate support throughout the system life cycle. SOC is directly supported by several outside organizations. Civil Engineering handles facilities related issues. The base communications squadron handles information technology equipment and services for SOC. Contracted items are passed

through the base contracting squadron. The base hospital provides military ambulatory care to faculty and students who become ill or are injured. The Air University library is also supports faculty and students. The base has a dedicated SOC chaplain and all standard chaplain services are available to students and faculty.

c. Administration Function

The administration function allows daily tasks to operate. SOC administration functions include providing students with documentation such as syllabus and reference materials. Registrar functions such as student or faculty records, in-processing/out-processing, and faculty leave are also administrative functions. Copyrights for lesson materials, scheduling resources, and monitoring resources fall under this function as well. SOC monitoring resources include tracking computer equipment and tracking funds.

d. Delivery Function

The delivery function is the means by which instruction is provided to the students. Workbooks, instructors, computers, simulations, and correspondence are all considered part of the delivery function. In SOC, there are two primary delivery functions. For the in-residence course, the SOS flight commander serves as the primary means of curriculum delivery. For the correspondence course, delivery is done electronically over the web. For both in-residence and correspondence, all lesson materials are delivered electronically via the web thru the SOC network.

e. Evaluation Function

To determine the system's worth, AF-ISD requires continuous identification, collection, and analysis of data. The evaluation function determines the value of instruction in meeting the institution's mission and goals. According to Air Force Manual (AFMAN) 36-2235v10, there are four basic attention areas during evaluation: (1) did learning (cognitive knowledge) take place, (2) were student's attitudes affected by their learning experience, (3) did a change in behavior take place, and (4) did the learning cause the student's organization to become more efficient and or effective.

(1) SOC evaluates cognitive learning through graded assignments. Some evaluations are graded essays, graded presentations, and flight commander evaluations of students during performance tests.

(2) Instructors subjectively evaluate student attitudes throughout the SOS class during events and lectures. SOC indirectly evaluates student attitudes by conducting end-of-course critiques. Student responses are used as an indicator of student attitudes.

(3) Behavior changes are measured during the graduate & supervisor satisfaction survey given six months after graduation. Graduates of SOS and their supervisors are questioned about behavioral changes.

(4) The supervisor satisfaction survey is also used to evaluate if the alumni student has become more efficient or effective.

Internal evaluations are used to assess changes in student learning or student attitudes. Internal evaluations monitor the quality of the course: whether or not learning took place and how do students see value in taking the course. SOC uses graded essays, graded presentations, flight commander evaluations, and end-of-course critiques as internal evaluations. External evaluations are used to assess if knowledge, skills, and attitudes learned in the course are making the student better at their primary job. SOC uses the graduate and supervisor satisfaction surveys as an external evaluation.

2. ISD Phases

According to Instructional System Development, embedded within the system functions are the four phases (United States Air Force, 1993).

- Analyze and determine what instruction is needed.

- Design instruction to meet the need.

- Develop instructional materials to support system requirements.

- Implement the instructional system.

a.   *Analysis Phase*

The purpose of the analysis phase "is to identify what to teach and how much to teach" (United States Air Force, 2002).

(1)   Educational Analysis.   The educational analysis starts by reviewing educational requirements and developing educational goals.   AF-ISD recommends that managers, instructional developers, subject matter experts, or system analyst are best suited to conduct the analysis.   The analysis should concurrently or sequentially perform the five steps.   First collect data.   SOC collects data through research in the overarching subject areas (communication, international security studies, leadership, profession of arms, and warfare).   Research is conducted by the SOC/DE curriculum developers advised by a curriculum area chairperson, typically a civilian with a doctorate degree.   Second, the learning outcomes are determined.   This is usually done by SOC/DE curriculum developers working underneath the curriculum area chairperson.   Third, the learning content (skills and knowledge) are determined.   Again, SOC curriculum developers work with the subject area chair to determine exactly what learning content is desired.   Fourth, outcomes must be prioritized in relation to meeting mission goals.   Learning outcomes are prioritized by the curriculum development department.   Finally, results must be documented.   SOC documents the educational analysis in the SOS syllabus.   AF-ISD recommends using someone knowledgeable about course content but not part of course development to review data sources found during the educational analysis (United States Air Force, 2002).   SOC uses its parent organization, Air University, to review the educational analysis.

(2)   Learning Analysis.   The learning analysis is the process to determine what type and what level of learning is desired.   AF-ISD uses Bloom's educational taxonomy to describe levels of learning (Bloom, 1956). SOC requirements are often stated in terms of learning type (affective, cognitive, psychomotor), but levels of learning must be determined by curriculum developers. Requirements are often stated at the lowest level of learning, but curriculum developers are free to increase the required level of learning not decrease it. During the learning analysis, a hierarchy of knowledge will be built to determine what should be taught.   At SOC, the curriculum area

chairpersons determine the desired hierarchy and use it in order to properly sequence instruction. The final learning analysis step identifies the prerequisite knowledge and skills of those being taught and those being instructed. SOC uses several sources to determine the prerequisite knowledge; the learning analysis assumes all SOS students have the knowledge and skills of a four-year undergraduate degree, pre-commissioning training, at least four years of military experience, and a company grade understanding of their primary duties.

AF-ISD recommends using someone knowledgeable about learning theory but outside course development to review the learning analysis (United States Air Force, 2002). Air University fills this role for SOC.

(3) Resource Analysis. The resource analysis identifies the types of resources that will be required throughout the instruction lifecycle. Resources for the instructional system include equipment, facilities, funds, personnel, and time. During the analysis, long and short term resources must be considered. Resources are managed by the mission support branch (SOC/MS). MS handles supplying all equipment such as computers, audiovisual resources, books, paper, and pens. MS also manages the SOC facilities from furniture to room assignments, to building repairs. Some SOC funding is also managed through the MS branch—contracted services such as Information Technology support and building cleaning. Overall operations and maintenance is directed by the SOC commandant through his budget staff. SOC determines personnel requirements based on mandated student throughput. Air Force level requirements dictate the number of students that must be processed in one year. SOC determines its personnel requirements based off this number. Time resources are also driven by Air Force level requirements. These requirements dictate how many training days are required per class per class. Instruction is designed around the number of available training days. Time resources for curriculum development are based on Periodic Comprehensive Review (PCR) requirements. SOC produces the PCR every 12-16 months with inputs from students and faculty. The PCR reviews the course requirements and ensures adequate coverage of those requirements. In the resource analysis, ISD recommends defining resource constraints early in the process. Some of the constraints,

such as manning, class length and class size, are defined up front by higher headquarters. Other constraints such as budgets are developed by the chain of command and change throughout the year based on the Department of Defense budget cycle. Planning does not always accurately define all the requirements; therefore, resource requirements must be continually updated. The SOC Commandant uses the annual Air Force/DoD Planning Programming and Budgeting System (PPBS) to update requirements.

AF-ISD recommends reviewing the resource analysis with someone knowledgeable enough to validate the resource assumptions but not involved in course development (United States Air Force, 2002). SOC uses its parent organization, Air University, to review its resource analysis.

(4) Target Audience Analysis. An Analysis of the target audience ensures the instructional system correctly matches the level of course content to the students. This analysis produces several types of data including a range of student aptitudes, background experience, education, physical characteristics, and subject matter expertise. Using data about the audience, the instructional designer can more accurately determine the best course content, level of content, delivery methods, course length, equipment needs, and affective strategies. Thru end-of-course critiques, after lecture surveys, and PCRs, SOC conducts its target audience analysis.

AF-ISD recommends reviewing the target audience analysis to validate any assumptions.

(5) ISD Management Plan Update. At the end of each phase, ISD recommends updating the management plan. Additional information gathered in each phase should be incorporated into the management plan.

b. Design Phase

The design phase determines what courses will be taught, how to measure student learning, how to teach the material, how to implement the course, and how to collect student and course data. AF-ISD creates a framework for use in any Air Force training or education program. Each design phase concept is explained in a general sense followed by the SOC specific application of each concept.

(1) Develop Objectives. Wherever evidence of learning is required, objectives are developed. Objectives are statements of what a student is expected to demonstrate after instruction. By stating the expected student behaviors, the objective guides the content of instructions. Objectives can be used to test students and show student accountability for meeting objectives. There are two types of objectives: terminal and developmental. At the end of a major portion of a course, required learning outcomes are stated in terminal objectives. Developmental objectives are used to evaluate incremental progress toward a terminal objective. SOC uses lesson objectives, the objectives contained in each lesson, as its developmental objectives. SOC then uses course objectives, found in the syllabus, as its terminal objectives.

During the design phase evaluation, course objectives should be evaluated to ensure they meet the intended levels of learning. SOC reviews course objectives during each PCR to ensure objectives are still relevant; the PCR looks at all of the learning requirements and explains how the curriculum covers those requirements. Faculty observations, written assignments, and student surveys are subjective, but used to evaluate the intended levels of learning.

(2) Develop Tests. During the design phase, a performance measurement program must be established. SOC's performance measurement program resides in each lesson; each lesson designer determines how learning will be assessed for his lesson. Assessments include written assignments, worksheets, discussions, and instructors evaluating student performance during experiential events. ISD states that tests must adequately measure the objectives they support and match the performance required by the objective. SOC currently uses written essays and performance testing. Written essays are used to evaluate knowledge, comprehension, application, and analysis skills of students in the curriculum areas. Currently, SOC has three essays on topics covering communications, leadership, and international security studies. These essays are used to evaluate if students are meeting standards for content knowledge and communications skills. Performance testing at SOC consists of graded briefings and leadership problem solving activities. Examples of performance testing include a formal briefing to the flight, team problem solving activities (Team Leadership Problems

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(TLPs), a Cultural Leadership Exercise (CLX), and Project X—a type of obstacle course). SOC primarily focuses on student evaluation during these events with some focus on measuring the instructional programs success. ISD states tests are used to identify problems with the instructional program as well as indicating if students are meeting standards. SOC looks at completed assignments, flight commander evaluations of students, and surveys to identify problems; however, these are subjective tests of students meeting standards. Surveys are the primary means used to identify problems.

During the design phase evaluation, test materials should also be evaluated to ensure they meet the intended levels of learning.

(3) Review and Use Existing Materials. AF-ISD encourages the use of existing instructional material during the design phase. The use of existing materials saves considerable time and therefore money and personnel. SOC curriculum developers do use existing materials from both in-house and other institutions. The use of these materials helps create an environment of spiral lesson development. Most curriculum developers have experience teaching the old curriculum and are inherently reusing existing materials due to their familiarity with existing material.

(4) Design Instructional Plan. During the design phase, the instructional method must be selected. According to ISD, the instructional method is the procedure of process used to attain an objective (United States Air Force, 2002). There are many instructional methods such as lectures, demonstrations, discussions, case studies, cooperative learning, and experiential. SOC curriculum developers choose the best instructional method based on their curriculum development training. Most frequently, a guided discussion is used to deliver instruction. Also used are lectures, experiential, and performance events. AF-ISD recommends placing emphasis on student-controlled learning situations versus instructor-led. SOC conforms to this guidance by delivering curriculum primarily through guided discussions versus formal lectures.

While designing the instructional plan, lesson plans are developed. Lesson plans are the plans produced to organize what is presented in a lesson. AF-ISD recommends a 10-step sequence for developing lesson plans. The steps of AF-ISD very

closely follow SOC's current curriculum development process. The following are the sequence for developing lesson plans:

1. Determine the objective.
2. Rough-out the evaluation instrument(s).
3. Finalize the evaluation instrument(s).
4. Research the topic defined by the objective.
5. Select the instructional method.
6. Identify your planning format.
7. Decide how to organize the lesson.
8. Choose the support material.
9. Prepare the lesson from beginning to end.
10. Prepare a final outline.

SOC's curriculum development follows the AF-ISD steps listed above.

During this phase, the presentation sequence can be designed for the entire course. Guidelines for sequencing include placing pre-requisite knowledge before points of application, broad concepts and technical terms early in the sequence, and placing cumulative skills late in the sequence. SOC sequencing is done by SOC/DE with inputs from curriculum developers most familiar with the lessons.

(5) Develop Implementation Plan. The implementation plan serves as the approval document for operation of the instructional system. It can be used as a resource and control document. It identifies the parameters of the system, type of instruction, instructional content, resource requirements, and milestones. Lesson plans, equipment lists, personnel documents, and other items are all part of the implementation plan. The purpose of the implementation plan is to document the system, identify resources, and set milestones. SOC uses operating instructions (OIs) as its implementation plan. SOC OIs detail the daily and strategic operations of SOC and lists responsibilities.

(6)   Design Instructional Information Management System.   In order to manage system information in real time, an automated information management system is desired.   The system can be used as a registrar function, to update student status, to update instructional materials, and to manage resources.   SOC uses a combination of information systems to manage information.   One system, iGecko, fills the registrar function.   Another system, SOC Blackboard, uses the commercial Blackboard™ software—an Internet-based learning management system. Blackboard™ is the primary method of faculty to student information interface.   The base computer network, including computer workstations, email, share-drives, and printing, are another important information system at SOC. This computer network is the primary information interface intra-faculty and between SOC and outside organizations.

(7) Update ISD Management Plan. At the end of each phase, ISD recommends updating the management plan.   Additional information gathered in each phase should be incorporated into the management plan.

c.   Development Phase

During the development phase, tasks such as producing media, writing tests, and writing materials will conclude.

(1) Prepare Course Syllabus. The course syllabus is used to detail the course contents.   It includes items such as course identification, objectives, sequencing, hours of instruction, instructor requirements, support materials, instructor guidance, and lesson plans. SOC maintains the entire student oriented information in the SOS course syllabus (course overview, course policies, course outcomes, course requirements). Instructor related materials are contained in SOC operating instructions.

(2) Develop Instructional Materials. In the previous phase, the best methods for instruction were selected.   During the development phase, course materials will be developed. There are a number of media that can be used; SOC uses primarily printed medium delivered electronically. SOC/DE curriculum developers have the responsibility to produce the media and ensure their correlation with evaluation.

(3)   Install Instructional Information Management System. Curriculum developers should consider several usability factors regarding their

information management system. Users (faculty and students) must be able to operate within the information management system. Adequate access to the system must be provided. The system must reliably present complete and accurate information. Usability factors are handled by the mission support (SOC/MS) branch while information accuracy, completion, and reliability are handled by SOC/DE curriculum department.

(4) Validate Instruction. Validation is used as a quality control tool during the development phase. Validation measures instructional effectiveness. AF-ISD uses five topics to cover validation: develop validation plan, conduct internal reviews, conduct individual tryouts, conduct small-group tryouts, and conduct operational tryouts. The first topic, developing a validation plan, provides a roadmap for the validation process making it structured and credible. SOC uses SOC OI 36-2 as the validation plan. This OI covers the operations of the academic branch SOC/DE and details the validation process. Internal reviews are conducted in DE by the curriculum developers, team leads, and curriculum area chairperson. Individual tryouts are conducted by the curriculum developers with a SOC audience—the curriculum developer briefs the lesson they have created explaining their rationale for choices in the lesson as well as how the lesson should be executed by others. These tryouts rely on experienced instructors giving written and oral feedback to the curriculum developer. Next, small group tryouts are used to evaluate new curriculum. A formative evaluation may be conducted using students from an SOS flight and a curriculum developer or other faculty as the instructor. Operational tryout is the last step, occurring in SOC when a lesson is formally added to the curriculum. All SOS flights will receive the lesson as part of a normal class and feedback will be gathered to determine if further changes are necessary.

(5) Evaluation during the Development Phase. Evaluations continue, as with previous phases, but the more mature materials from the development phase may require going back to the design or even analysis phase. The feedback mechanisms during the development phase should ensure instructors are in contact with course developers. In SOS, faculty committees, such as the academic committee are used to give feedback to course developers.

(6) Finalize Instructional Materials. Instructional materials must be finalized to ensure they are ready for implementation. Materials must be current, accurate, and complete. SOC materials are finalized and delivered through the information management systems.

d. *Implementation Phase*

During the implementation phase, all system functions must be in place with adequate resources before instruction begins. At SOC, implementation means conducting Squadron Officer School classes. Flight commanders are dedicated to implementation. Curriculum developers will move to a support role during typical implementation and continuing working on the curriculum. SOC ongoing activities during implementation include conducting instruction, managing resources, faculty development, and evaluation. During implementation, students are receiving instruction 4–8 hours a day in one of three typical formats: class room instruction, large lecture hall instruction, or experiential events. Classroom instruction comprises 80% of the course. Classroom activities include guided discussion lectures, informal lectures, and experiential events. The large lecture hall is used exclusively for formal briefings. Most experiential events occur outside (Project X, Teambuilding Exercise, and Warrior Challenge). Flight Commanders are used for curriculum delivery in the classrooms while faculty or guest speakers are used in the large lecture hall. Experiential events are delivered by flight commanders, sometimes using multiple flight commanders per flight.

C. SOC AND SOS CONCEPTS

Since 1950, SOC has been shaped around several different concepts.

1. Past Concepts

The first commandant of Squadron Officer College, Colonel Russell V. Ritchey conceived the idea of junior officer school in 1950. The Air Tactical School was closing giving Colonel Ritchey the opportunity to invent a school for junior officers to learn the skills necessary to perform at the staff and command levels. The original SOC was an 8- week course devoted to the study of organization, written expression, oral expression,

staff instruction, and problem solving. Air University, the primary stakeholder, allowed Colonel Ritchey's staff a great deal of freedom in designing the course objectives (Ritchey, 2000). Colonel Ritchey did not detail why course objectives were chosen or how stakeholders were involved. In 1954, the course length was increased to 14 weeks most likely due to lessons learned from the Korean conflict and a reduction in forces. In 1974, the Air Staff decreased the length to 11 weeks in order to increase attendance opportunities from 52% to 85%. Again, in 1980, the course was shortened to increase attendance, this time to 8.5 weeks. In 1989 the Air Staff wanted 100% attendance by all line captains so the course was shortened to 7 weeks. In 1998, the Aerospace Basic Course (ABC later called the Air and Space Basic Course or ASBC) was added to SOC sharing the same facilities as SOS. In order for SOC to accommodate both schools, SOS was shortened to 5 weeks with an 80% opportunity rate for all line captains (Donovan, 1999). Throughout SOS history, the tradeoff between learning outcomes and cost have been decided by higher headquarters dictating course length in order to increase enrollment (Manacapilli, 1998). Even today, course length is still fixed and the college must determine how to best meet objectives within the allotted time.

2.   Current Concepts

For the past decade, SOC has offered a 5 week SOS in-residence and a self-paced correspondence course. The 5-week course offers enough slots to allow attendance of 80% of all captains with 4 to 7 years. The correspondence course was intended to offer the same education to captains and civilians who were not able to attend. Over the years, some home station organizations have imposed requirements that a student must complete SOS in-correspondence before he can be selected to attend in-residence. Because a large number of students complete SOS in-correspondence before arriving to the in-residence course, the correspondence curriculum uses different lessons in order to avoid repeating curriculum. There are five core subject areas in SOS: communication, international security studies, leadership, profession of arms, and warfare. The majority of the curriculum (80%) is centered on leadership studies.

During the in-residence course, learning objectives are accomplished through lectures, assignments, and experiential events. Most of the lessons are delivered in the flight room by the flight commander. The primary method of delivery is the guided discussion—the instructor uses series of questions in order to stimulate student discussions that provide answers and experiences to facilitate learning. Students are given required readings that must be completed the night before each lecture. A small percentage of the lectures are given to the entire student body in the large Polifka Auditorium. Assignments are used to measure students written and oral communication skills. Assignments include a paper and briefing on the student's background and current job, a paper studying a leadership situation, and an international security studies paper. Experiential events are team problem solving activities that give students an opportunity to apply leadership and problem-solving concepts. Examples include Project X—a combination of obstacle and confidence course. Each project X task gives a team of six students 15 minutes to travel across various obstacles with various restrictions on communication and movement.

The correspondence course is a self-paced correspondence program. Lesson materials are available electronically and consist of required readings. After reading the required material, the student can take a multiple choice test at his or her home station's education office. There are five tests, one in each of the core subject areas. A student must pass one test in order to progress to the next area. If a student fails any test more than three times, they are disenrolled and must start the course over. Students have 18 months in order to complete all five tests.

3. Future Concepts

In 2011, Air Force leadership decided that ASBC was no longer affordable. It was terminated and SOS was given the opportunity to increase course length to 8 weeks with 100% opportunity for all line captains. The last ASBC class graduated in July 2011 and the last 5 week course will finish October 2011. The first 8-week SOS will

commence in January 2012 with updated curriculum in the same five core subject areas. Delivery methods and events will be similar to the current structure with more time devoted to each core subject area.

D.   MEASURING THE SYSTEM

SOCs system is intended to produce better leaders. SOC uses several tools to evaluate the in-work processes and the final product. Some measurements deal with course content and delivery while some focus on evaluating course effectiveness at developing a CGO. The ultimate goal of SOC is to produce better leaders, but despite a great deal of leadership theory research, measuring leadership growth has been proven very difficult.

1.   Measurement by Students

Students have the opportunity to evaluate the SOC system at three points in time: during class, at the end of the course, and six months after graduation. Lecture surveys are developed by ESS/XA, an Air University organization dedicated to developing and interpreting surveys of military education units. According to Kirby Thompson, SOC faculty development, surveys use a Likert scale and ask questions related to course content, method of delivery, and instructor competence (K. Thompson, personal communication, October 2, 2011).

During class, students are tasked with filling out surveys after specific lectures. These lecture surveys allow the student, while still being processed thru the course, to give immediate feedback. The feedback is used by curriculum developers to evaluate if lessons meet objectives.

Students' second measurement and feedback opportunity occurs in the end-of-course survey. This survey is given within 4 days of graduation after about 95% of the lessons have been delivered. The end-of-course survey provides feedback on the course objectives, taking into account the entire curriculum of SOS. These surveys are used to measure satisfaction with the instruction and curriculum.

Six months after SOS graduation, students are sent a survey via e-mail. The survey allows students to evaluate the effectiveness of the SOS content on their job. This type of survey measures the student's behavioral application of the SOS curriculum.

2. Measurement by Faculty

Faculty has two formats to measure the system. The most used measurement is student evaluations. Each student will be evaluated by an instructor during several events. Evaluations include graded written and oral assignments, such as essays and formal briefings, to determine if students understand and apply the curriculum. Instructors also evaluate experiential events for student application of curriculum. One example is Project X. During a Project X event, the instructor will evaluate the leadership and problem solving characteristics of each student. All of these instructor evaluations are intended to measure student behavioral application of the SOS curriculum.

Faculty's second form of measurement is informal feedback at the end of each class through the chain of command. These end-of-course feedbacks also serve as a measurement of the system. Faculty can subjectively suggest changes in the course that they believe will improve the system. Many of the changes are based on faculty observations of student learning and satisfaction with various aspects of the instruction. This feedback is routed up the chain of command allowing inputs from the lowest faculty level (instructors), through operations officers, squadron commanders, and finally to the commandant.

3. Measurement by Supervisors

Six months after students graduate from SOS, their supervisors will be sent a survey via email. According to Arden Gale of the Spaatz Center Education Support Squadron, the survey asks the supervisor if they are satisfied that learning objectives were met (A. Gale, personal communication, November 29, 2011). This survey is the customers' most direct feedback mechanism into the SOC system. These surveys are also used a measurement of the behavioral change of CGOs.

4.   Measurement by Stakeholders

There are four different stakeholder boards that have influence on SOC primarily through requirements: the Command Board of Advisors (CBOA), Board of Visitors (BOV), Military Education Coordination Council (MECC), and Air Force Learning Committee (AFLC). The CBOA is held by AETC and its influence on requirements relate to the CESG requirements document. The BOV is made of no more than 35 individuals serving 2-year terms and "is responsible for matters pertaining to the educational, doctrinal, and research policies and activities of Air University, and for advising the Secretary of the Air Force, through the Commander, AU" (United States Air Force Air University, 2009). The MECC advises the Joint Staff and works as a feedback mechanism for the OPMEP (Chairman of the Joint Chiefs of Staff, 2009). The AFLC is a general officer level committee and the "governing body for adding, deleting or modifying existing ancillary training requirements" for the Air Force. AFLC must give approval before the Air Force can fund, develop, or field any ancillary training requirement (United States Air Force, 2011). All of these committees are at high levels and suggestions are made through committees that have a wide range of responsibilities such as all of professional military education. Stakeholder measurements can occur indirectly when requirements are changed or new requirements are developed. Figure 8 shows the relationship between the requirements process and measurement by stakeholders.
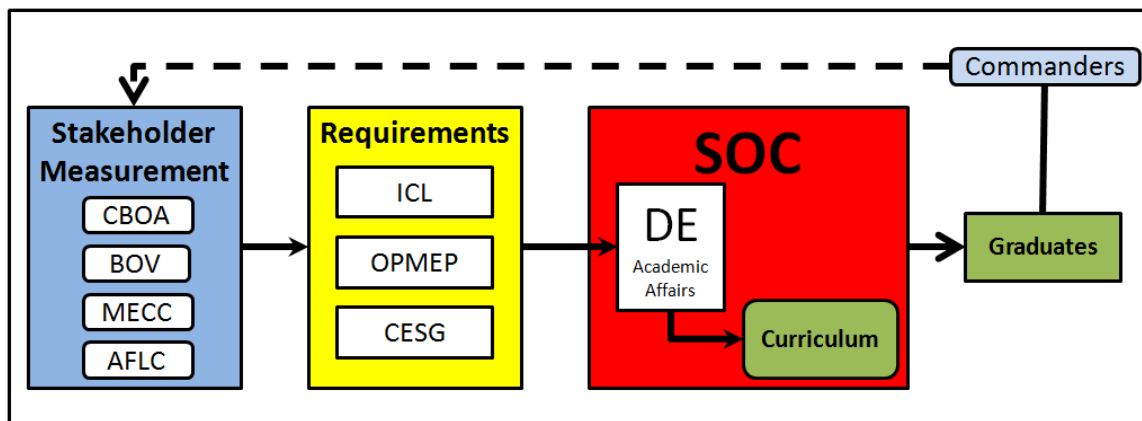

Figure 8.   Measurement by stakeholders through the requirements process.

5.   Measurement Difficulties

There are several problems with the aforementioned measurements. Lesson objectives are written using Bloom's taxonomy, and there is no definite amount of time required to meet a certain level of cognitive learning. Therefore, lesson length and course length are not quantitatively determined.

Another problem is the reliance on student surveys to evaluate student attitudes and learning. There is a strong potential for bias in the student surveys. For example, items that receive a large number of negative comments in the end-of-course survey are usually given special attention and sometimes the lesson is re-written. Surveys do not take into consideration which students are producing end-of-course comments. One form of student bias is due to the competitive nature of SOS and Air Force officers. Students who feel they have lost or were cheated are more likely to be vocal than students who are satisfied. Flights are competing head-to-head for honors and students in each flight are competing for honor graduate distinction. For example, the Project X obstacle course is a team experiential event; for each obstacle completed, a flight earns 1 "mission point." Mission points are awarded for success during events at SOS and used to determine the top flight. Some students who are unsuccessful at Project X will claim the event is unfair or that it does not teach anything; these students are the most likely to write survey comments about Project X. The overwhelming majority of students will find Project X useful and meaningful, as evidenced by Likert-scale ratings, but will simply rate the event high on the Likert-scale and not write any comments at the end-of-course.

Other forms of student bias occur when curriculum events are entertaining rather than educational. Formal lectures given to the entire student body in Polifka Auditorium are usually surveyed by students. Positive survey results are usually dependent on the lecturer's briefing skills and not the educational content. This phenomenon is evidenced when two different lecturers have been used for the same lecture, and one lecturer is rated much higher than another for the same content.

While students are stakeholders, this process does not take the customer into consideration. In the past, comprehensive, multiple choice tests were used to objectively

assess student learning. The test was eliminated in 2009 during a curriculum re-write. Despite its objectivity, assessing higher levels of learning with multiple choice tests is problematic.

Using satisfaction surveys to measure educational effectiveness is also problematic. It is extremely difficult for a supervisor to determine if an SOS graduate is better at his job directly because of his SOS experience 6 months after graduation. Further complicating measurement, there is not a comparable control group to SOS graduates; CGOs who are not selected to attend in-residence training are considered the lowest job performers.   The mandatory nature of SOS can also skew satisfaction results. Many students do not want to attend SOS, but must due to the career implications. Some of these students will express satisfaction in surveys if a class was easy rather than challenging.

Supervisor surveys are intended to be the most direct form of feedback from the SOC customer. According to Arden Gale, these surveys have very low completion rates, around 4% for 2009, but due to the large sample size there is statistical significance (personal communication, November 29, 2011). Unfortunately, these surveys can only measure indirect changes in student behavior. Supervisors are not intimately familiar with SOC curriculum; it would be difficult for a supervisor to know if lesson objectives are being met and if CGOs are applying the lesson objectives. Another important note is that many CGOs supervisors are not commanders. Commanders, the ultimate SOC customer, do not have a direct feedback mechanism into SOC. While there are formal feedback processes such as the CBOA, BOV, MECC, and AFLC, only students and supervisors are able to frequently and continually give SOC feedback. Inputs from these boards tend to be reactionary to the existing system instead of giving feedback during the system development. The lack of customer feedback is a major deficiency in a systems engineering approach.

E. CHAPTER SUMMARY

The SOC organization is shaped heavily by its chain of command. In order to accomplish its mission, SOC is organized around the AF-ISD model. SOC very closely follows each step of the ISD model. The model is well suited for developing curriculum, particularly in a spiral process.

There are many similarities between the past and current SOS course. SOS has consisted of two parts; an asynchronous correspondence course and an in-residence course. The driving design factor throughout SOC history has been the desire to increase in-residence opportunities for captains by reducing the course length.

System measurement is done through surveys and assessments, but these tend to have bias and do not fully utilize commanders as stakeholders. System measurements focus on student surveys, supervisor surveys, and command boards. None of these systems involve stakeholder inputs during the system design.

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IV.   DESIGN FACTORS AND DESIGN SPACE

In order to recommend a new construct for the SOC system, all of the factors affecting the system must be understood.

A.   STAKEHOLDERS

There are several stakeholders for SOC, but the primary stakeholders in SOC are Air Force commanders. Commanders' ultimate influence as a stakeholder occurs in through the Air University Command Board of Advisors. The board provides the Air University commander with feedback regarding AU's products and programs. The board meets at least once a year and members include each major command's vice commander, as well as the deputy director of the Air National Guard (United States Air Force Air University, 2010).

The military chain of command dictates some of SOC's stakeholders; each higher level is responsible for the ones below it. Therefore, SOC's parent organizations, the Spaatz Center for Officer Education, Air University, and Air Education and Training Command are also stakeholders. These same stakeholders also influence the funding of SOC. A lower level on the chain of command receives its budget allocation from the parent organization. In many cases, priorities can be decided by the amount of funding made available or by not providing funding at all.

Students are stakeholders in the SOC system as well. While the student may only be at SOS for five weeks, the effects of SOC on that student have the potential to last an entire career or lifetime.

The SOC faculty members are the most involved stakeholders in the SOC system. While commanders have other duties and responsibilities, and students are only in the SOC system five weeks of their entire career, the faculty is involved in the system full time. The faculty is what makes the system work, taking requirements and turning them into the final product, educated CGOs.

Although the public's role in influencing the SOC organization is very indirect, the public is a stakeholder as it funds and supports the government. As a government organization, SOC is inherently a sociotechnical system (Maier & Rechtin, 2002). As part of Air University, SOC also must consider the Commission of Colleges of the Southern Association of Colleges and Schools, which accredits Air University.

B.   COMMANDERS

The ultimate customers of the SOC product are Air Force commanders. Commanders will employ company grade officers to execute their mission. Commanders expect their troops to be effective and efficient when executing the mission. The SOC product is a more effective and efficient CGO. When designing the SOC system, the first question that must be asked is, "What knowledge, skills, and attributes do all Air Force commanders require of CGOs?" Second, "which of those items are allocated to SOS for development? To what depth are those items covered at SOS?" Defining the system thru this lens will ultimately answer the essential problem of producing the most effective CGO. Commanders will make inputs into the three requirements documents (ICL, CESG, and OPMEP) that drive the SOC system. More directly, commander inputs are gathered through commander feedback surveys, which also shape the system.

C.   STUDENTS

The students of SOS (captains and civilian equivalents) are the product that SOC produces. There are several design factors that stem from the students. Students possess varying levels of baseline knowledge, things students have learned from education and experiences. Also, students have varying levels of knowledge they can learn while at SOS according to adult learner theory (Knowles, 1984).

SOC curriculum is developed with an understanding of what knowledge and skills a baseline student will possess. Air Force officer standards are used to start a baseline. To become an Air Force officer, an individual must have completed a baccalaureate degree from an accredited university. Officers must be at least 17 years old when they are commissioned and must be able to complete 20 years of service before their 55th birthday (United States Air Force, 2008). To earn the rank of captain, individuals

must be commissioned for 4 years. SOC students typically complete high school, then college, making them at a minimum 21 years old when attending SOS. Most SOS students are older, having been enlisted in the military before commissioning or taking longer to complete college. While students on-the-job experience varies greatly, as a minimum each SOS student will have 4 years of experience as an Air Force officer. SOS students must also have a current Air Force physical fitness passing score.

In their pre-commissioning source, officers receive basic education in many of the same subjects taught at SOS. Basic Officer Training (BOT) has 97.5 hours of leadership curriculum, 41.5 hours of Communication Studies, 113 hours of Warfare/International Security Studies, and 64 hours of Profession of Arms curriculum (Holm Center for Officer Accessions and Citizen Development, 2011).

Approximately 80% of SOS students attended the ASBC previously offered at SOC. According to Captain Will Boyd, SOC faculty development, ASBC shared approximately 50% to 80% of its curriculum with SOS (personal communication, December 8, 2011). While the curriculum topics were similar, ASBC lectures were tailored to first year officers with less experience than the four to seven year captains at SOS.

D.   COST

When designing the SOC system, cost is a significant design factor that influences all other factors—SOC's only funding is its federal budget. The number of faculty and students is the greatest contributor to cost. Increases in manpower or student throughput increase cost.

Resident course direct costs are driven primarily by operations and maintenance. For each faculty member and student, the organization must provide administration, training, equipment, and facilities. SOC pays the cost of its faculty and all equipment. The cost to send and house each student at SOC is the responsibility of the student's home unit. Student costs are travel ($1,200 average per student), lodging ($39 per day), and per diem ($27 per day) (S.C. Lipinski, personal communication, November 8, 2011). For a total of $3,391.50 per student on average (34 days including travel, 33 lodging

days, 75% per diem rate on two travel days). Many students bear additional costs that could not be accurately measured: rental car cost, taxi fares, additional travel days, and family separation allowance for students with dependents. These costs would likely bring the average cost per student closer to $4,000.

Non-resident course costs include faculty, facilities, and equipment to host the course. There are no student costs directly paid by the home unit.

E.   SCHEDULE

The current SOS schedule is driven by the number of days SOC allocates to meet all learning objectives. The SOS curriculum schedule is a top-down requirement; given 25 days of instruction, cover all requirements. A systems approach would build a schedule by flowing requirements down, creating a work breakdown structure (lessons), determining the time for each element, and then adding all the elements to determine the total time. In the new build, the course and learning objectives should be determined, then as all lessons are built to satisfy the objectives the hours necessary would be determined. The sum of the hours after designing all lessons would determine the length of the course.

The externally imposed length of the course limits the design space. With SOC manpower and cost held constant, course length determines the system throughput. Under the current system, a 5 week in-residence course, held seven times a year produces about 3,000 graduates per year. This cycle allows 80% of all eligible captains to attend. In order to produce 100% attendance, an upcoming plan of an 8-week course, held five times a year, will require a 200% increase in instructor manning.

The current schedule design for in-residence courses is sequential. After completing each 5- or 8-week class, there are 2 weeks of preparation until the next class starts. Class preparations could be completed in 1 week if necessary. The correspondence course is continuous; a student can enroll at any time and has 18 months to complete the self-paced course.

F.   MANPOWER

Student throughput is not only dependent on schedule; instructor manpower has significant effects on student throughput. The current SOS system uses one instructor per 14 students. Originally, in-residence SOS used 12 students per instructor based on typical military members' daily interactions within a unit and an ideal student/teacher ratio (Ritchey, 2000). SOS moved to 14 students per instructor to address throughput requirements. Classroom lessons, assignments, and experiential activities are designed around the 1:14 teacher/student ratio. This ratio has ramifications in the lesson delivery. For example, the predominant lesson delivery method, the guided discussion is selected due to its applicability in small groups. Management and support manning is proportionate to the instructor manning. For example, if the mandated throughput of SOC is 3,700 students, arranging students in 14-member flights requires 264.3 flights (3700 ÷ 14 = 264.3). Using 15-member flights requires 246.7 flights (3700 ÷ 15 = 246.7). In the construct of a 5 week SOS, seven times a year, adding one more student per flight decreases the total number of instructors by two per year. By holding the number of instructors constant at 32, the total output of SOC in one year is 3,136 for 14-member flights and 3,360 for 15-member flights. Increasing the flight size by one student adds 224 students to the total yearly throughput. In an 8-week SOS, adding one student to a flight increases yearly throughput by 160 students per year.

The correspondence course does not require any fixed instructor/student ratios; the correspondence course is all multiple-choice testing completed at the students home unit.

In order to make calculations and predictions, the manning data for the January 2012 class will be used. The first class will consist of 58 flights, but the total number of flights will decrease slightly over the year. Faculty will decrease proportionally; therefore the student to faculty ratios will remain constant. Figure 9 is a visual representation of SOC manning by branch. SOC has a total of 160 faculty members in its 4 branches. In all of SOC, there are 121 personnel qualified to instruct (Figure 10). Virtually all of the military members are qualified to be an instructor (Figure 11). Administrative assistants, civilians, and enlisted personnel are not permitted to be

instructors. Commanders (13) and executive officers (2) are qualified as instructors, but do not normally instruct. Directors of operations (DOs) (8) do not instruct when there is sufficient manning. For the January 2012 SOS Class, there will be 58 instructors in the classroom out of the 91 instructor qualified SOS personnel. According to Kirby Thompson, SOC faculty development, instructors teaching their first class will be accompanied by an experienced instructor; typically 5–10% of the instructors per class (personal communication, October 2, 2011). Turnover due to reassignment also reduces the number of available instructors by one to eight instructors per class; an instructor will only teach if he will be present for the entire class.

SOC Total Manning by Branch (160 Personnel)

- Command Section
- Academic Affairs
- Mission Support
- SOS

22.5%
8.8%
8.1%
60.6%
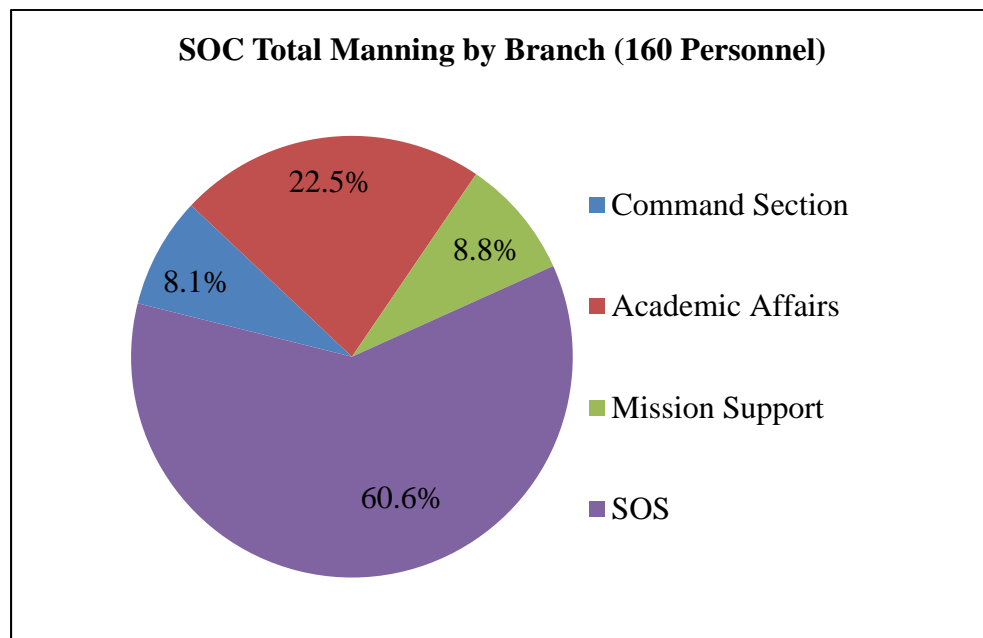
Figure 9.   SOC total manning by branch (From United States Air Force Squadron Officer College, 2011).

SOC Personnel Qualified as Instructors

0%

Not Eligible
(civilians,
enlisted,
lieutenants,
chaplain)
23%

Qualified as an
Instructor
75%

Eligible, Not
Qualified
2%
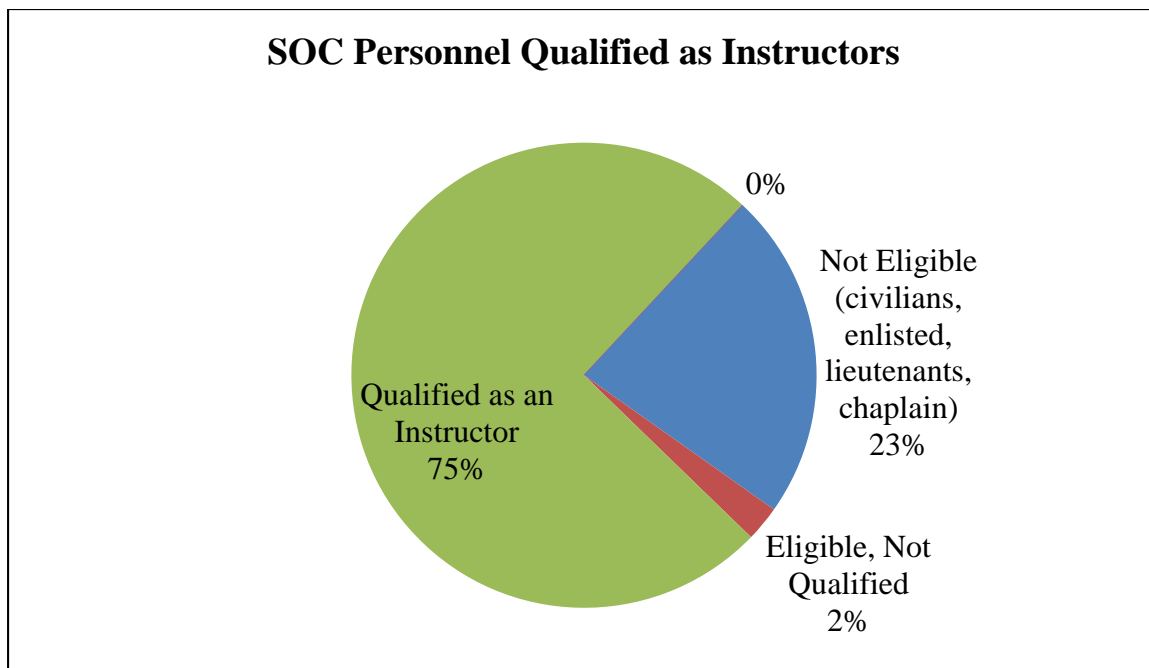
Figure 10.   Percentage of SOC staff qualified as instructors (From United States Air
Force Squadron Officer College, 2011).

SOC Qualified Instructors by Branch

Legend:
- Total Assigned
- Instructor Eligible
- Instructor Qualified

X-axis categories: Command Section, Academic Affairs, Mission Support, SOS

Y-axis: 0, 20, 40, 60, 80, 100, 120

Figure 11.   SOC instructor qualified personnel (From United States Air Force
Squadron Officer College, 2011).

G.   LEARNING REQUIREMENTS

Learning requirements are directed by higher headquarters via various documents: Officer Professional Military Education Policy, AF Institutional Competencies List, Air Force Instructions (AFI), AF Learning Committee (AFLC), Air University Continuum of Officer and Enlisted Professional Military Education Strategic Guidance, and commander guidance. The ICL and corresponding CESG documents limit the scope of the system to five subject areas: profession of arms, military studies, international security studies, communications studies, and leadership studies. The OPMEP provides broad guidance for primary professional military education; it states that the curriculum should primarily address the tactical level of war and foster an understanding of joint warfighting. The hierarchy of commanders for SOC from top to bottom is Air Education and Training Command (four-star general), Air University (three-star general), Spaatz Center (two-star general), SOC (colonel). The learning requirements stated in these documents leave a large amount of design space to SOC and commanders. SOC develops objectives that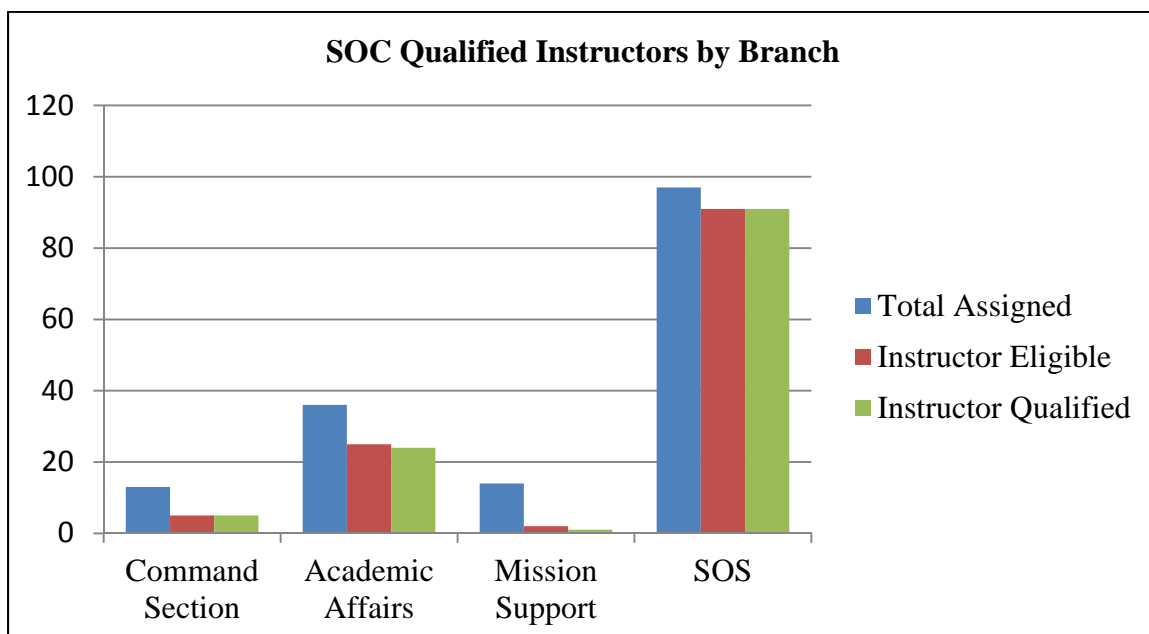 satisfy the requirements. There is no set ratio of objectives to requirements; a single lesson may cover several requirements or several lessons may cover one requirement. The number of classroom hours, activities, and assessments are not prescribed in any of the requirement documents.

H.   CHAPTER SUMMARY

Identifying SOC as a system aids in making design decisions. First, stakeholders include the military chain of command, students, faculty, and the public. Air Force commanders are SOC's customers and educated students are SOC's product. The course design is based on the knowledge, skills, and attributes that commanders want CGOs to possess. The course is designed to build upon the knowledge a baseline student, having met certain prerequisites, would have.

Cost is a significant factor when designing the SOC system. Scheduling and manpower are also significant factors affecting the SOC system design. The greatest cost to Air Force units is travel costs to the in-residence program with lodging, per diem, and other incidentals making the average cost per student over $3,400 per student. Correspondence course costs are minimal.

The course is designed around the given number of instructional days. Before 2012, the requirement stated 25 days of instruction are required and the course designed around that requirement. Another significant factor in course design is the instructor-to-student ratio. SOS has used a 1:14 ratio for decades and the entire course from lessons to classrooms are designed around this ratio.

Learning requirements are delivered through three key documents: the ICL, OPMEP, and CESG. While these documents are the ultimate guide in determining what to teach, there is great flexibility for SOC to choose the number and depth of lessons to meet requirements.

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V. SYSTEMS ENGINEERING APPLICATIONS

SOC could benefit from using a systems engineering approach to redesign its curriculum.

A. VALUE OF A SYSTEMS APPROACH

Systems engineering has evolved as a robust method to enable complex systems. The International Council on Systems Engineering (INCOSE) uses the following definition (INCOSE, 2011):

> Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality *early* in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem.

SOC stakeholder inputs are given after the system is implemented. Throughout its history, SOC has formed a system, performed its function, and then asked if it is meeting customer needs. Further diminishing stakeholder inputs, customer needs are indirectly evaluated by surveys and not explicitly included in system design. Evaluating customer needs through supervisor satisfaction surveys is problematic in its reactionary approach. The true customers, commanders, do not have a direct input during system design.

> INCOSE (2011) also states the following:

> Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

The SOC system, due to its continuous operations, may not be considering all customer needs. Higher headquarters has mandated course length changes over the last 61 years without fully considering the system life cycle, business or technical needs. Continuous operations means that the instructors, significant stakeholders, cannot be fully immersed in the system redesign. Stakeholders, such as commanders and the Command

Board of Advisors, have so many responsibilities, that they cannot be expected to meet with all other SOC stakeholders and determine how to best implement the SOC system.

Blanchard and Fabrycky define a system as "an assemblage or combination of elements or parts forming a complex or unitary whole" (Blanchard & Fabrycky, 2006). A system is made of components, attributes, and relationships.

"Components are the operating arts of a system consisting of input, process, and output. Each system component may assume a variety of values to describe a system state as set by some control action and one or more restrictions" (Blanchard & Fabrycky, 2006). In SOC, branches or divisions could be considered components. For example Academic Affairs (DE) is the curriculum development component, the Student Squadrons are the instruction component, the SOC front office group is the management component, and Mission Support (MS) is the support component. Similarly, SOC components could also be described by their role in ISD as functions or phases.

"Attributes are the properties or discernible manifestations of the components of a system. These attributes characterize the system" (Blanchard & Fabrycky, 2006). In SOC, attributes can be viewed as the mission of each of the components. The most discernible manifestations would be new curriculum for DE, instruction from the Student Squadrons, and information technology support from MS.

"Relationships are the links between components and attributes" (Blanchard & Fabrycky, 2006). The relationships between SOC components and attributes are numerous and complex. For example, when updating curriculum, Student Squadrons may initiate the need for a change, which academic affairs will start using individuals previously in the student squadrons and with iterative inputs from the students squadrons during various stages of development. Logistics requirements for the new lesson will go through MS, and management will oversee the entire operation of each component. It is because of these complex relationships, that a systems approach should be used to improve SOC.

B.   STAKEHOLDER INVOLVEMENT

Stakeholders are any person that can affect or be affected by the project or system (Forsberg, Mooz, & Cotterman, 2005). As discussed before, commanders, students, faculty, and the public are all stakeholders in the SOC system. In a systems approach, stakeholders are involved throughout the system's lifecycle to ensure customers are receiving what they want.

Project management is "the process of planning, applying, and controlling the use of funds, personnel, and physical resources to achieve a specific result" (Forsberg, Mooz, & Cotterman, 2005). Project management at SOC is headed by the SOC Commander/Commandant and is managed through each of the SOC divisions' military chain of command (MS, DE, and Student Squadrons).

Forsberg, Mooz, and Cotterman (2005) define systems engineering as the following:

> The process of managing requirements to include user and stakeholder requirements, concept selection, architecture development, requirements flowdown, and traceability, opportunity and risk management, system integration, verification, validation, and lessons learned.

The Chief Academic Officer (SOC/CF), a doctorate advisor to the SOC Commandant, is analogous the systems engineer. The overall course objectives, course sequencing, requirements flowdown, and feedback cycles are headed by the SOC/CF. Many of these system engineering functions are delegated to academic affairs for execution, but are ultimately decided by the Chief Academic Officer.

Requirements management is "management of the project business, budget, and technical baselines congruent. The process includes baseline change management and authorization. Also included are requirements flowdown, traceability, and accountability" (Forsberg, Mooz, & Cotterman, 2005). For SOC, requirements management falls upon both the Commandant and the Chief Academic Officer and is delegated down through Academic Affairs (DE).

C.   REQUIREMENTS PROCESS

When defining system requirements, the initial definition of the system requirements is necessary to ensure the effectiveness of early decisions (Blanchard & Fabrycky, 2006). System requirements should be well defined, traceable, and visible.

After completing a top-level description of the system, the next step is the functional allocation of requirements (Blanchard & Fabrycky, 2006). When partitioning the system, closely related functions should be identified and grouped. In the case of SOC curriculum, requirements from the CESG, ICL, and OPMEP are group along the five subject areas (profession of arms, warfare, leadership, communications, and international security studies). Within each of the subject areas, requirements are grouped to form lesson objectives. Partitioning has allowed some subject areas to mix into a single lesson, but overall, the subject areas are the starting point of partitioning.

In the systems approach, during the process of partitioning and functional packaging, trade-off studies are used to evaluate different design approaches for a given functional requirement (Blanchard & Fabrycky, 2006). SOC should evaluate different design approaches in several of its functions. The curriculum development function is currently conducted by the curriculum development branch, which is separate from the curriculum users, flight commanders. SOC should evaluate the potential of integrating the curriculum development function into the Student Squadrons. The function of curriculum delivery (correspondence and in-residence) has been looked at in the past and should be reexamined to determine if there is a more beneficial design approach (blended learning for example).

Architecting is defined as "the art and science of designing and building systems" (Maier & Rechtin, 2002). System architecture is established when the system operational requirements, maintenance concepts, support concepts, and technical performance measures are defined (Blanchard & Fabrycky, 2006). The system architecture will lead to a functional architecture.

D. CAPACITY ANALYSIS

The true capacity of SOC can be determined by calculating throughput based on manpower, facilities, and schedule.

Instructors have a large impact on throughput. In the new 8-week SOS course, 58 instructors with flights of 14 students can process 4,060 students per year. If all 91 SOS instructor qualified staff were used to instruct, throughput would increase to 6,370 students per year. If all 121 instructor-qualified SOC personnel were used, throughput would be 8,470. There are ongoing functions at SOC that would preclude using every qualified instructor: sick leave, curriculum development, management, administration, reassignment, and deployments reduce the number of available instructors. Using more instructors has a significant impact on total throughput.

Facilities limitations can occur from a number of sources. If all 94 flight rooms were equipped to have students, yearly throughput would be 6,580 students. The number of students per room is limited by the floor space available for chairs and tables. A room with 14 students would be considered comfortably full, however, the physical space could allow up to 28 students (plus one instructor) per room. Teresa Nihart, Maxwell Air Force Base Billeting Manager, states billeting currently has 850 rooms available for SOC students and has the capacity to increase by 150 rooms if no other base organizations increase their billeting requirements (personal communication, December 9, 2011). If all 1,000 rooms were made available, 71 flights could be housed per class; yearly throughput would be 4,970 students. The large lecture hall can hold approximately 1,220 students at one time, limiting class size to 87 flights per class or 6,090 students per year. The Project X facility has 22 obstacles; therefore a maximum of 22 flights can participate simultaneously. In order for each flight to complete Project X it takes 4 hours. Project X can therefore handle two sessions per day totaling 616 students or 3,080 students per year without staggering the schedule. Staggering the Project X schedule multiplies the capacity by the number of days staggered; for example conducting 2 days of project X allows 6,160 students per year (3,080 * 2 days).

SOC Capacity for 8-Week Course, 14 Students per flight

■ Total Student Throughput per Year

Category	Total Student Throughput per Year
All Qualified SOC Instructors Teaching (121)	8470
Flight Rooms (Max 94)	6580
Shortened Class Preparation Time (8 classes/year)	6496
All Qualified SOS Instructors Teaching (91)	6370
Project X (2-day staggered schedule)	6160
Lecture Hall (1,220 Max)	6100
Billeting (Max 1000)	5000
8-wk Course 1-wk prep time, continuous schedule)	4327.96
Current config. (58 instructors, 58 flight rooms)	4060
Project X (22 obstacles, two runs per day)	3080

Table 2.   SOC capacity for an 8-week course.

The current schedule limits the number of classes per year to five. Reducing the class preparation time and continuing operations regardless of fiscal year can increase throughput. For example, an alternate schedule can be estimated by assuming 48-weeks are available for class each year (52-weeks per year minus 4 weeks for annual leave) and by relaxing the amount of preparation time. Each class consists of 1 week of class preparation plus the course length (5 or 8 weeks). Using a sequential schedule where each SOS class starts and ends at the same time, a 5-week course can be held a maximum of eight times a year. An 8-week course can be held a maximum of five times a year. If classes are not constrained to the fiscal, academic, or calendar year, 5.33 classes could be completed within 48 weeks; a continuous schedule has the capacity to produce about 4,327.96 graduates per year (5.33classes*58flights*14 students per flight).

Comparison of 5-week vs. 8-Week Course, 58 Flights, 14 Students per flight

■ Total Student Throughput per Year

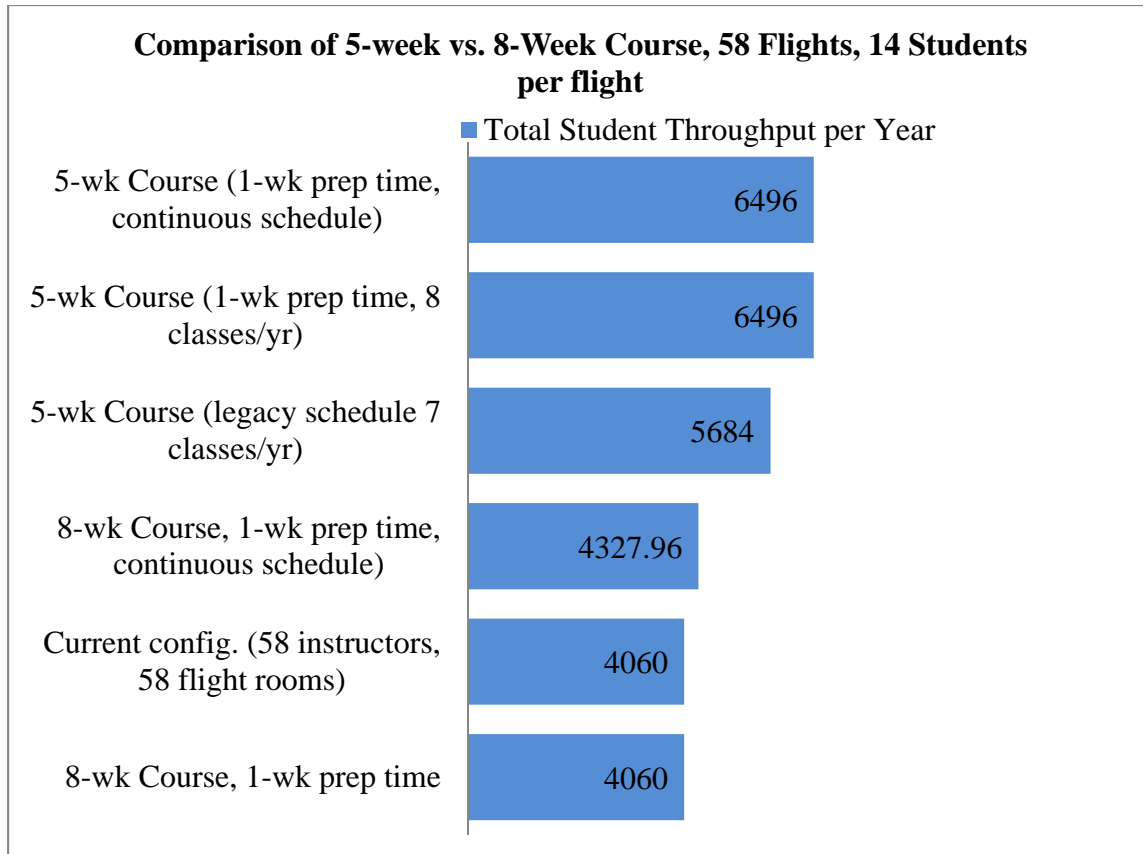| Course Configuration	Total Student Throughput per Year
5-wk Course (1-wk prep time, continuous schedule)	6496
5-wk Course (1-wk prep time, 8 classes/yr)	6496
5-wk Course (legacy schedule 7 classes/yr)	5684
8-wk Course, 1-wk prep time, continuous schedule)	4327.96
Current config. (58 instructors, 58 flight rooms)	4060
8-wk Course, 1-wk prep time	4060

Table 3.   SOC capacity based on 5- or 8-week courses.

One method of determining SOC capacity is determining the number of student-weeks. Using student-weeks allows one to tradeoff course length or the number of graduates. With 91 available SOS instructors, each with 14 students per class and 48 weeks available per year, there exists the potential for 81,312 student-weeks.

E.   CHAPTER SUMMARY

Systems engineering practices could be applied to the SOC in order to improve this complex system. Stakeholders in SOC, such as the project manager, system engineer, and requirements manager need to understand their roles in the systems context. The requirements process is a major factor in shaping the current SOC system and must be analyzed in order to identify potential improvements.

SOC capacity has historically been adjusted by altering the length of course. There are other design factors that can be manipulated in order to increase student throughput. In its current capacity, SOC does not appear limited by facilities such as billeting or classrooms. Scheduling changes, such as reducing down time between classes, increases throughput slightly, but the design factor that has the greatest effect on throughput appears to be the number of active instructors. SOC currently uses most of its qualified instructors to teach, but further efficiencies in administration or organization should be explored to increase the percentage of staff available to instruct.

VI.   IMPROVING THE SYSTEM

SOC is part of a larger system for managing Air Force personnel. Changes to the external environment are more difficult to implement than changes to the internal system. Because of this, this thesis recommends a three phase approach to improving SOS. The first improvement phase does not change the current course syllabus and focuses on increased throughput. The second phase addresses the need for a continuous improvement cycle involving the stakeholders and may change the course syllabus and length. The third phase examines delivery modalities to determine potential benefits.

A.   FACTS AND ASSUMPTIONS ABOUT THE TRADESPACE

In order to improve SOC, it is important to distinguish facts and assumptions about the tradespace. The first assumption is the time available to conduct an in-residence course will be held to eight weeks. Historically, the class length is directed by higher headquarters and SOC must develop its curriculum within this constraint. Another assumption is that the Air Force will send 100% of all line officers to attend an in-residence program (which is the current guidance set forth during CORONA 2011).

There are several facts influencing the SOC mission. There are approximately 3,700 eligible CGOs that must attend SOC each year. The course length is fixed at eight weeks, and one week of class preparations are needed before each period. Each class will have 700 to 800 students divided into flights with one flight commander dedicated to each flight. There is one lecture hall to accommodate the entire student body at once and a second lecture hall to accommodate 138 students at once. There is space for 94 flight rooms. According the Mission Support branch chief, Stephen Wales, not all flight rooms are currently configured to have students, but the necessary chairs, tables, computers, and audiovisual equipment could be acquired in a reasonable amount of time at some expense (personal communication, November 10, 2011).

Other assumptions must be made in order to analyze the tradespace. The minimum amount of time needed for class preparation is one week. Currently SOS has two weeks of preparation before each class. The current flight size will remain

14 students per instructor. There are advantages to increasing or decreasing flight size—increased flight size increases yearly throughput while decreased flight size maximizes the student to teacher ratio. SOC manpower, currently 160 personnel including civilians, will remain constant. The current annual operations budget, $1.6 million, will continue with an adjustment for inflation. Historically, when a CGO is at home station, he or she will not be given time during the duty day to work on SOS. The assumption will be that all students learned and still understand the pre-requisite curriculum from their pre-commissioning source; therefore, there will not be any remediation in those subjects. Remediation time is not being considered because it will decrease the amount of time available for the course, therefore reducing the level of learning for many other students. While the in-residence course is held to eight weeks, we will assume that using proper e-learning principles, portions of the in-residence material can be completed through other media.

B.   PHASE I: INCREASING SOC THROUGHPUT

Throughout SOC history, the Air Force has attempted to increase SOC throughput. Most times, the answer to increasing throughput was decreasing course length. The full tradespace has not been explored for other ways to increase the number of SOS graduates. While holding the SOS syllabus constant, there are several design factors that can be manipulated to increase the number of students who graduate each year.

Increasing the percentage of SOC staff who are actively instructing will increase the student throughput. In upcoming construct, each instructor can process 70 students per year (14 students per flight, five classes per year). The current SOC organization uses former instructors to develop curriculum. Personnel assigned to the curriculum department have typically completed one to two years as an instructor and finish their three year tour writing curriculum. During the major curriculum rewrites such as 2009 and 2011, the curriculum department requires an increase in personnel to produce an all-new curriculum. After the curriculum rewrite, the workload is significantly decreased. SOC could use a spiral curriculum development process in order to level the workload.

In a spiral approach, a smaller curriculum staff would rewrite a few lessons at a time and introduce them into the course. The additional curriculum personnel could be placed back into instructing. The spiral approach would also reduce instructor workload because only a few lessons at a time would change. The drawback to a spiral curriculum development is when a large curriculum rewrite is mandated (such as the 2011 decision to increase SOS to 8 weeks); there is spin up time to train instructors to be curriculum developers. In order to reduce spin up time, instructors can be trained rotationally; after becoming an instructor, an individual would train as a curriculum developer, write curriculum temporarily, and return to instructing where manpower numbers have the greatest effect on throughput. Similarly, the curriculum development could be moved into the student squadrons, so that instructors who are not actively writing curriculum could be instructing.

Non-instructing positions should be reduced in order to increase the number of people available to instruct. Administrative and support positions should be examined for redundancies. Qualified instructors should not be used for purely administrative roles. Currently 121 of the 160 SOC staff are instructor qualified, or 76%; in the first class of 2012, 58 instructors are required, or 36% of the staff. Most of the remaining staff perform management and support functions instead of providing instruction.

Increasing the length of the instructor tour would increase student throughput. A typical instructor is assigned to SOC for 3 years with the first 2 years as an instructor, the last year as a curriculum developer or administrative position. Initial instructor training takes 1 month, and if an instructor has not completed SOS as a student, it may require an additional 2 to 3 months to start instructing. Increasing the length of tour increases the percentage of a tour that an individual is instructor qualified. Increasing the length of tour at SOC currently may have negative career implications. A SOC assignment is considered a career broadening assignment; staff members are outside their primary career field and may fall behind their peers in technical expertise and career progression. Similarly, the Intermediate Developmental Education (IDE) select staff is only at SOC for a total of 2 years. IDE select staff members are majors, selected by Air Force Personnel Command, who work at SOC for 2 years and then attend Air Command and

Staff College in-residence. IDE select officers are selected from the top 20% of majors, which adds prestige and credibility to the instructor cadre. The drawback of using IDE selects is they are only instructor qualified for approximately 22 months and many move into administrative positions, which further reduces the amount of time they actively instruct.

Another way to increase the number of available instructors is to eliminate distance learning. Because SOS will allow 100% opportunity for attendance in the future, there should be little need for a distance learning option. There may still be a few cases where line officers cannot attend due to mission requirements such as deployments. If in-residence SOS were the only option, those few officers would be more likely to create an opportunity to attend. The greatest drawback of eliminating distance learning is the missed opportunity for some students to attend. They include non-line officers (chaplains, Judge Advocate Generals (JAGs), and medical personnel), government civilians, Guard, and Reservists who do not have 100% opportunity to attend. According to Captain Will Boyd, in 2010, 12% of SOS slots were available for all Air Force civilians, guard, international officers, and reservists (personal communication, December 8, 2011).

One way to increase throughput is to increase flight size. Flight size was increased in the past in order to increase throughput (the original SOS had 12-member flights; the current SOS has 14-member flights). Much of the curriculum is specifically designed for 14-member flights, but a systems engineering approach would allow the redesign of the course with larger flights. The key to this redesign would be including the increased flight size in the requirements instead of taking curriculum already designed for 14 students and simply adding more students. The potential drawback for increasing flight size is the decrease in learning effectiveness. A careful study of the tradeoff between larger class sizes and learning effectiveness would need to be conducted to ensure the desired levels of learning are still reached.

Another way to increase throughput is by holding more classes per year. In order to increase the number of classes per year, the class preparation time must be reduced.

During the 5 week SOS, there were 2 weeks of preparation time between each SOS class, allowing seven total classes per year—adding an additional 420 students per year. If class preparation time were reduced, then a total of eight classes would fit within 1 year. In an 8-week curriculum, there will be five total classes per year with 2 weeks of preparation, but there could be six classes by decreasing preparation time. This has the potential of adding 600–800 students per year. The downside of shortening preparation time is the increased operational tempo of instructors. There is risk that instructors will become burned out from such a schedule. The need for a longer preparation period is related to the complexity and workload of the SOS course. For example, during the 2009 curriculum rewrite, instructors were given more assignments to grade and less time during the work day to grade. Also, instructors had to learn new material to teach and new assignments to grade. As the curriculum stabilized, the grading time was worked into the schedule and the number of graded assignments was reduced. As instructors become more familiar with lessons and assignments, they need less time to prepare. The preparation period should be examined for potential efficiencies in order to reduce the amount of time needed between classes.

Staggered scheduling of SOS classes could increase throughput. Officers and commanders must work in-residence attendance around primary duties, deployments, and other training. Given the small number of start dates and longer course length, students may find it more difficult to schedule attendance. By offering more start dates, SOC may accommodate more individual's schedules. Staggered scheduling could also reduce logistical burdens of SOC support staff. For example, when the SOS schedule requires the use of the running track, start times for each flight must be staggered throughout the day, which can extend the staff's total duty day. In the upcoming 2012 classes, materials will be needed for 840 students each day. Staggered scheduling could reduce the daily demand for a specific resource by 50%. The drawback of staggered scheduling may be an increased administrative workload. For example, in-processing of students would occur 10 times a year instead of five. Guest speakers would be required twice as often or some students would have to attend guest lectures out of sequence with the course syllabus.

C.   PHASE II: CONTINUOUS IMPROVEMENT CYCLE

Using a continuous improvement cycle, SOC could benefit from a better understanding of customer requirements and be better equipped to make design tradeoffs. In particular, updated requirements may shorten or lengthen the course syllabus. The tradeoffs in phase I focused on the design space set by the current requirements and syllabus. By using a systems engineering approach to addressing stakeholder requirements, SOC may be able to identify other factors in the design space.

The spiral development model is a risk-driven approach for the development of a system. This model does not require the use of prototypes and incorporates feedback during the entire system lifecycle. This system engineering process model is iterative and allows one to evaluate risk before proceeding to the next phase (Blanchard & Fabrycky, 2006). Using spiral development, risk would occur when course objectives are not being met. Examples of increased risk include curriculum not meeting commander requirements, cost increases that do not increase learning effectiveness, or the method of instruction does not lead to student learning.

The past cycles of curriculum rewrites could be considered spiral development. As new curriculum is being developed, curriculum developers often reference and reuse previous lessons. The curriculum rewrites are often a response to a major change in requirements, such as increased course length, and are intended to be a new and unbiased look at meeting course objectives. SOC should use spiral development in a more responsive way by constantly spiraling individual lessons and spiraling even when requirements have not changed.

Spiral development at SOC could use prototypes in different ways. When curriculum is changed, portions of the student population could be subjected to prototype lessons to test learning. This is currently done by taking a flight of students and giving them an extra lesson, usually instructed by a curriculum designer, and surveying the student and faculty who participate. Often the new lessons are similar to current lessons that students have already seen during the course. In order to get true measurements of improvements, SOC should experiment by directly comparing a control group (who uses

the old lesson) and a test group who is only exposed to the new lesson. Also, an entire course could be prototyped by selecting a small number of flights to test an entirely different curriculum or different delivery modalities. Some leaders worry the prototype flight may completely miss some learning objectives, but allowing a fully prototyped class will more rapidly test and incorporate design changes.

Spiral development incorporates feedback throughout the development cycle, both during a spiral and between spirals. Feedback from stakeholders, particularly the customer, should be worked into the process. Currently, the course must be fully implemented before customers can give inputs. There is not a system in place to incorporate stakeholder inputs during the development process. When the SOS curriculum is static, the two-year cycle for the Command Board of Advisors makes sense. During curriculum overhauls, the response time for stakeholders is not frequent enough to allow feedback to affect the course design. Also, customer feedback format must be changed in order for SOC to be more responsive to customer needs. The current cycle provides customers with an opportunity for approval or disapproval of the product after the fact instead of during course design. Instead of a binary approval/disapproval, more efforts should be made into collecting customer needs and then translating and allocating needs to requirements.

By more frequently involving stakeholders, SOC can more rapidly address changes to requirements. The frequent changes in warfare may lead to changes in PME requirements. In order to respond to changes in warfare, SOC must receive customer inputs and then enter the curriculum development cycle. For example, since the 2001 and 2003 invasions of Afghanistan and Iraq, the military has required more cross-cultural training. It was not until 2009 that SOC added its cross-cultural curriculum. Also, SOC did not have a class addressing social media until late 2009, at which point over 250 million people were registered on Facebook (Facebook, 2011). If commanders and other stakeholders were able to identify a training need, SOC could develop tailored curriculum to service commander needs in a more expedient fashion.

D. PHASE III: DELIVERY MODALITIES

For this effort, delivery modalities will be defined as different forms of instruction, either online, face-to-face, or a combination of both (Barelka & Schuelke, 2011). The proposed modalities are based on the current modalities and those possible new modalities that would fit within the tradespace. By exploring the curriculum delivery methods, SOC may become more effective or efficient at delivering curriculum. Each modality is described and advantages or disadvantages to manpower, cost, and learning are discussed.

1. Asynchronous Correspondence Only

Asynchronous correspondence SOS is the presentation of materials via the Internet or website. Students would not have an instructor and progression would be self-guided within a time frame.

Eliminating in-residence SOS would achieve significant cost savings due to the significantly reduced staff numbers. Of the 160 SOC personnel, currently there are 4 full-time faculty supporting correspondence plus 3 contractors compared to 98 faculty members supporting in-residence SOS execution; most of the remaining 55 personnel would still be required for curriculum development and mission support. A correspondence only course would require the least amount of manpower; it would eliminate most in-residence instructors and most of the Mission Support branch. Facilities would also be significantly reduced: the Ritchey Center and its staff, Project X obstacle course, sports fields, the SOS classrooms, and two large lecture halls would not be necessary.

The drawback of correspondence is the lack of instructor-to-student and student-to-student interaction. These interactions significantly improve learning (Stricker, 2009). All evaluations would be based on academic situations and no practical experiences from experiential events. Correspondence students' assessments are limited by the communication medium. Currently multiple choice tests are used for correspondence, but if the in-residence personnel become available, written assignments would be able to receive the same level of assessment. Presentation and briefing skills could be assessed,

but NOT to the fidelity of having a person in front of a real audience. Testing can accurately assess the knowledge level of learning, however higher levels of learning are more complicated to test (Wiggins, 1998). Evaluators cannot easily assess soft skills without seeing a student interact with others in person.

2. Synchronous Online Only

An online only SOS would consist of live meetings via the Internet. Students would have a set schedule that they must attend classes via the Internet or some other real-time media.

An online SOS would have cost savings for home units because students would not have travel and temporary duty (TDY) costs. Some SOS facilities and faculty would be reduced: the Ritchey Center and its staff, Project X obstacle course, sports fields, SOS classrooms, two large lecture halls, and a portion of the mission support personnel. Correspondence manning could be eliminated. Instructor and other SOC manning would remain about the same. Information technology costs may increase to acquire and maintain an online lesson delivery system. SOC is already well configured to use information technology; costs would primarily be for licensing software for live meetings and continued technical support.

Similar to a correspondence only course, the online only course may impact learning effectiveness. The complex, interpersonal tasks that characterize SOC's leadership course may be difficult to accomplish without having students and teachers face-to-face. Evaluations without face-to-face interaction may also prove difficult.

3. In-Residence Only

An in-residence only SOS would consist of an 8-week course held at Maxwell AFB, which all CGOs must travel to attend.

Offering SOS in-residence only may be the most expensive option. Trade-offs would have to be made between opportunity for attendance and course length. Increasing course length reduces the probability of attendance by all captains. Decreasing course length lowers the amount of material that can be covered at SOS. Eliminating the

correspondence course only frees a few resources, namely seven personnel in the SOC organization, and test facilitators at each home station (who would still have other educational duties). Costs may increase very slightly due to the need to furnish more classrooms and additional administrative burden. The in-residence only would require a full complement of instructors.

Learning effectiveness and evaluation of students appears to be easiest in a face-to-face environment, but careful studies should be conducted to prove this.

4. Blended Learning

The blended learning approach can be conducted in one of two ways. The first blended learning option would use a pre-requisite correspondence course followed by an in-residence course. The second option is a pre-requisite online course followed by an in-residence course.

Both blended learning options would decrease the amount of time students are away from home station, but only reduce the needed SOC faculty by a minimal amount, if any. Information technology costs would increase for online delivery software. Travel costs per student would only be reduced by the billeting cost and per diem of the number of days reduced from the in-residence course ($66 per day per student).

a. *Correspondence and In-Residence Blended Learning*

Students would first complete all non-interactive lesson objectives through a traditional correspondence course. The correspondence course would use lesson materials such as readings, worksheets, and written exercises to establish baseline knowledge before students attend an in-residence course. Correspondence would be completed immediately before attending in-residence to ensure students have the pre-requisite knowledge needed for interactive work and application. The in-residence course length could be significantly shortened if most of the curriculum were completed before students arrived. Approximately 39% of the lessons require personal interaction. These lessons include team problem solving events, the Project X obstacle course, and senior leader discussions. One of the objectives of SOS is to learn to build teams. In-

residence flights are currently encouraged and evaluated on their teambuilding skills. Reducing the in-residence course does reduce the amount of practical teambuilding application that can be accomplished by students.

b.   *Online and In-Residence Blended Learning*

Having an online course delivery before the in-residence class allows students to apply teambuilding skills before physically meeting the students for interactive lessons. After students have interacted online for the non-interactive lessons, students will attend the residence course to complete all of the interactive lessons. The online portion would be completed immediately prior to arriving at the in-residence course. Again, a drawback of reducing the in-residence course is the reduction in practical teambuilding application that can be accomplished by students.

E.   CHAPTER SUMMARY

By identifying the tradespace, SOC can better understand the constraints that it must work within while improving the system. When defining the tradespace, it is important to separate facts and assumptions in order to maximize potential design options. For this analysis, the current SOC parameters are used: an 8-week course, 1:14 teacher/student ratio, static manning, and static funding. Stakeholder requirements must be fully understood in order to precisely model the tradespace.

For over 60 years, the Air Force has attempted to increase throughput by decreasing the SOS course length. Besides course length, there are several other design factors being overlooked that can be manipulated in order to increase throughput: increasing the number of instructors, reducing administrative requirements, increasing instructor tours, eliminating distance learning, increasing flight size, reducing preparation time, and staggering class start times. Each of these options has benefits and drawbacks. Many of these options require further research in cost effectiveness and the effects on education quality.

Implementing a spiral development system engineering process would improve system effectiveness. Spiral development practices should be used to update curriculum

instead of major curriculum rewrites. Comparing control groups, curriculum developers could validate new lessons or an entire course before full implementation to all CGOs. This would allow the most effective learning to be achieved thru testing and validation. Currently stakeholder involvement is not responsive but reactionary. More efforts should be put into capturing and implementing customer requirements. Spiral development is more conducive to stakeholder feedback because inputs can be taken during development instead of after execution, and SOC can more quickly address changing requirements.

The delivery methods of curriculum offer several design trade options. Using different modalities to deliver curriculum, SOC may find cost, manpower, or time savings. Using non-resident forms of the course would have the most significant cost savings however the effects on learning could be catastrophic. More research should be conducted to determine the effectiveness and efficiencies that may be gained by using different modalities. SOC should study the numerous civilian institutions that have embraced new modalities to address customer requirements.

VII. APPLICATIONS OF STUDY

A. RECOMMENDATIONS

While the SOC system is working, using a systems engineering approach promises to yield several improvements. In the systems engineering approach, stakeholders are instrumental to the entire process. Feedback should be solicited during the entire systems lifecycle in order to ensure customer satisfaction. While stakeholders are involved in SOC's curriculum, more frequent interaction and participation would ensure customers' are receiving the best possible product. The current stakeholder feedback processes are too slow to respond to a dynamic environment and too indirect to ensure the customer's needs are met.

Professional Military Education policy makers should consider constraints other than reducing course length to increase student throughput. Increasing the number of instructors and reducing the administrative burdens on SOC would increase throughput without requiring massive curriculum changes.

While SOC has processes to ensure continuous improvement, a true spiral development effort would ensure SOC is agile enough to meet changing customer needs. SOC must constantly update curriculum to prevent massive curriculum overhauls.

SOC should experiment with different prototypes in a spiral development of curriculum. Different modalities should be tested in prototype lessons and courses. Individual lessons should also be continually prototyped in order to hasten curriculum changes and test improved forms of learning.

During curriculum creation, the objectives should flow down from the requirements. While every effort is made to ensure flow down, some objectives seem to flow up from the lessons. For example, during the 2011 curriculum re-write, most of the requirements were grouped into the exact same lessons from the previous curriculum. A true systems approach would group the requirements without considering the previous design.

Standards for student measurement, such as grading papers and evaluating experiential performance, are very susceptible to bias. Well-defined standards are the starting point, but increased training and evaluations will minimize bias. One way to measure bias is by tracking instructor history during grading and experiential events. Since flights are assigned randomly each class, a flight has an equal chance of being first or last in mission points. Each flight will participate in the exact same experiential events during each SOS class with only flight commanders varying within a class. Tracking completion rates and times by each flight commander would identify potential bias during experiential events. Grades also could be tracked to determine bias. Due to the potential career implications for students, more efforts should be made to reduce instructor bias.

B.   AREAS TO CONDUCT FUTURE RESEARCH

There will always be a tradeoff between educational effectiveness and cost. Students will always be able to learn more if given more time, money, and other resources. In a resource-constrained environment, operational and educational needs are in competition. Previous Air Force leadership decisions have stated the importance of professional military education and the desire to maximize the number of graduates, however, efforts to increase enrollment have come at the expense of educational effectiveness. Course length has been the single most used design factor in shaping SOC, but research has not looked at the reduced course length effects on educational effectiveness. While course length is an important design factor, course designers and stakeholders need to take into account all other factors in the tradespace. In order to understand the implications of changing course length, research should look at the time required to meet educational objectives to the satisfaction of customer requirements.

Many civilian universities have been exploring the potential benefits of different delivery modalities. There is not yet a definitive answer, but the effects of different delivery modalities should be studied specifically in the SOC curriculum context. Delivery modalities will most likely be explored for cost savings, but educational effectiveness should also receive adequate attention.

Current measurements of customer and stakeholder satisfaction are inadequate. A great deal of emphasis is placed on student surveys and other subjective measures of learning. Commander surveys should be given more attention because commanders are the customer. More research should be placed on how to gather and incorporate customer feedback.

C. CHAPTER SUMMARY

Some key systems engineering concepts will fit well within SOC's current construct. Stakeholder involvement and spiral development are essential to improving a system. There are still several areas that need further research in order to truly optimize the SOC system. Educational effectiveness will always be bound by cost, and the optimization of educational effectiveness will require a great deal of research. Delivery modalities promise to increase the tradespace, but due to new technologies and theories, optimizing delivery will be difficult but should be explored.

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LIST OF REFERENCES

Barelka, A., & Schuelke, M. (2011). *A general e-learning theory*. Interservice/Industry Training, Simulation, and Education Conference. Wright Patterson Air Force Base: Air Force Research Lab.

Blanchard, B. S., & Fabrycky, W. J. (2006). *Systems engineering and analysis*. Upper Saddle River, NJ: Pearson Prentice Hall.

Bloom, B. S. (1956). *Taxonomy of educational objectives*. New York: Longman.

Chairman of the Joint Chiefs of Staff. (2009). *Chairman of the Joint Chiefs of Staff instruction 1800.01D officer professional military education policy* (OPMEP). Washington, D.C.: Author.

Clark, R. E., Bewley, W. L., & O'Neil, H. (2006). Heuristics for selecting distance or classroom settings for courses. In H. Oneil, & R. Perez (Eds.), *Web-based learning: theory, research and practice* (pp. 133–142). Mahwah: Lawrence Erlbaum Associates.

Donovan, M. O. (1999). *SOS history paper*. Maxwell Air Force Base: Squadron Officer School.

Facebook. (2011). Retrieved December 9, 2011 from http://www.facebook.com/press/info.php?timeline

Forsberg, K., Mooz, H., & Cotterman, H. (2005). *Visualizing project management*. Hoboken: John Wiley & Sons.

Goldstein, I. L., & Ford, J. K. (2002). *Training in organizations: Needs assessment, development, and evaluation* (4th ed.). Belmont: Wadsworth.

Holm Center for Officer Accessions and Citizen Development. (2011). *Holm Center syllabus MMOPM–BOT-MOTS-001 pre-commissioning training: Basic officer training*. Maxwell Air Force Base: Author.

International Council on Systems Engineering. (2011). Retrieved November 9, 2011, from http://www.incose.org/practice/whatissystemseng.aspx

Knowles, M. (1984). *The adult learner: A neglected species* (3rd ed.). Houston, TX: Gulf Publishing.

Maier, M. W., & Rechtin, E. (2002). *The art of systems architecting* (2nd ed.). Boca Raton, LA: CRC Press.

Manacapilli, T. (1998). *AF/LRP white paper*. Maxwell Air Force Base: Squadron Officer School.

Mayrath, M. C., & O'Hare, M. B. (2009). *A proposed method for converting Squadron Officer School into a blended-learning course with live, virtual, and constructive simulations*. Austin: Institute for Advanced Technology, The University of Texas at Austin.

Morrison, G. R., Ross, S. M., & Kemp, J. E. (2007). *Designing effective instruction*. New York: John Wiley.

Ritchey, R. V. (2000). *Years of the tiger*. Maxwell Air Force Base: Air University Press.

Stricker, A. G. (2009). *Why affective learning in a situated place matters for the millennial generation*. Maxwell Air Force Base: Air University.

Sugrue, B. M., & Clark, R. E. (2000). Media selection for training. In S. Tobias, & J. D. Fletcher (Eds.), *Training and Retraining: A handbook for business, industry, government and the military* (pp. 204–234). New York: Macmillan Reference.

The Air Force in Facts and Figures: 2011 USAF almanac. (2011, May). *Air Force Magazine*, 41.

United States Air Force. (2002). *AFH 36-2235 vol. 10 information for designers of instructional systems design: application to education*. Washington, D.C.: Author.

United States Air Force Air Education and Training Command. (2011). Retrieved November 8, 2011 from http://www.aetc.af.mil/

United States Air Force. (2002). *Air Force handbook 36-2235 vol.1 information for designers of instructional systems - ISD executive summary for commanders and managers*. Washington, D.C.: Author.

United States Air Force. (2008). *Air Force instruction 36-2013 officer training school and enlisted commissioning programs*. Washington, D.C.: Author.

United States Air Force. (2011). *Air Force instruction 36-2201 Air Force training program*. Washington, D.C.: Author.

United States Air Force. (2010). *Air Force instruction 36-2301 developmental education*. Washington, D.C.: Author.

United States Air Force. (1993). *Air Force manual 36-2234 instructional system development*. Washington, D.C.: Author.

United States Air Force. (2008). *Air Force policy directive 36-26 total force development*. Washington, D.C.: Author.

United States Air Force Air University. (2011). Retrieved November 8, 2011 from
http://www.au.af.mil/au/

United States Air Force Air University. (2010). *Air University catalog*. Maxwell Air
Force Base: Author.

United States Air Force Air University. (2009). *Air University continuum of officer and
enlisted professional military education*. Maxwell Air Force Base: Author.

United States Air Force Carl A. Spaatz Center for Officer Education. (2011). Retrieved
November 8, 2011 from http://www.au.af.mil/au/spaatz/

United States Air Force Squadron Officer College. (2011). *Headquarters Squadron
Officer College staff directory*. Maxwell Air Force Base: Author.

United States Air Force Squadron Officer College. (2011). Retrieved October 1, 2011,
from http://sos.maxwell.af.mil/

van Merrienboer, J. J. (1997). *Training complex cognitive skills: A four-component
instructional design model for technical training*. Englewood Cliffs, NJ:
Educational Technology Publications.

Wiggins, G. (1998). *Educative assessment: Designing assessments to inform and improve
student performance*. San Francisco: Jossey-Bass.

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